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# ACTA SOCIETATIS ZOOLOGICAE BOHEMOSLOVACAE \*)

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NEW *LEISTUS* S.STR. FROM EASTERN ASIA (COLEOPTERA, CARABIDAE)Jan FARKAČ<sup>1)</sup> & Andrei PLUTENKO<sup>2)</sup><sup>1)</sup> Španielova 1286, CS-163 00 Prague 6, Czechoslovakia<sup>2)</sup> Khersonskaya 23-58, 692812 Artem, Russia

**Abstract.** *Leistus (Leistus) janae* sp.n. from the Russian Far East is described and compared with *Leistus juldusanus*, *Leistus semenovi* and *Leistus frater*.

During a coleopterological expedition to the Sikhote Alin Mts. (Far East of Russia, Primorskiy Kray) we found 9 specimens of *Leistus* (5 males, 4 females) of the subgenus *Leistus* s.str. (sensu Perrault, 1980) in a scree field on the highest mountain (Oblachnaya, 1750 m) of the southern part of the range. After comparing these beetles with the species of the subgenus *Leistus* s.str. described so far (Perrault, 1986, 1988) we establish here a new species for these specimens.

*Leistus (Leistus) janae* sp.n. (Figs. 1 - 4)

**Description** (measurements in mm): Body length 8.5 - 9.0 (♂♂), 8.9-9.4 (♀♀); pronotum (♂♂) 1.6-1.7 long, 2.0-2.2 wide, (♀♀) 1.6-1.8 long, 2.0-2.3 wide; elytra (♂♂) 4.8-5.1 long, 2.8-3.2 wide, (♀♀) 5.0-5.5 long, 3.0-3.3 wide. Ratio of the length of pronotum to its width 1.27; ratio of the width of elytra to the width of pronotum 1.43; ratio of the length of elytra to their width 1.60. The anterior margin and basis of pronotum coarsely punctate, its shape is shown in Fig. 1. Elytral humeri indistinct. Eyes normal. The apical part of penis markedly dilated and flat, a longitudinal lamella slightly indicated (Figs. 3-4). Mandibles (Fig. 2). Body dark brown with a metallic lustre.

**Affinities:** Differential diagnosis is based on the shapes of mandibles, pronotum and apical part of penis. *L. janae* sp.n. differs from *Leistus juldusanus* Reitt. by shorter and wider mandibles (Fig. 2 and Perrault, 1986); from *Leistus frater* Reitt. by the shape of penis (Figs. 3-4 and Perrault, 1988); from *Leistus semenovi* Perrault by a different ratio of the width of elytra to the width of pronotum (*L. semenovi* 1.72, *L. janae* 1.43).

**Holotype:** ♂, Mt. Oblachnaya, 1750 m a.s.l., Sikhote Alin Mts. mer., Russia or., 23.06.1992, Jan Farkač legit and coll.

**Paratypes:** 4 ♂♂ (Nos 1-4), 4 ♀♀ (Nos 5-8), the same data as on the holotype, ♂ No 1 and ♀♀ Nos 5-6 legit and coll. Jan Farkač, ♂♂ Nos 2-4 and ♀♀ Nos 7-8 legit and coll. Andrei Plutenko.

**Type locality:** Scree field at about 1750 m a.s.l. under the peak of Mt. Oblachnaya. All the specimens were found under the surface layer of stones.

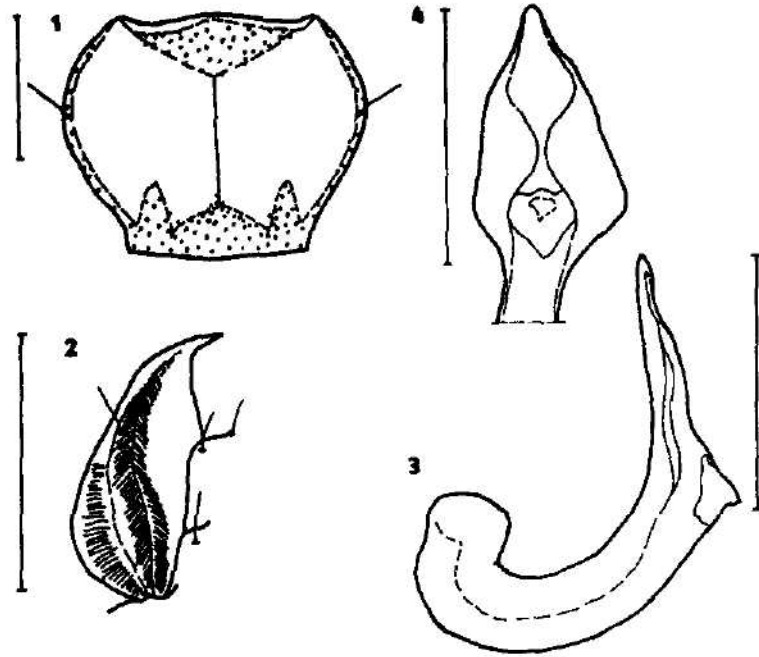
**Derivatio nominis:** The name of the new species is dedicated to Jana, wife of the first author.





#### Acknowledgement

We thank Prof Karel Hôrka (Faculty of Science, Charles University) for valuable advice and a loan of literature.



Figs. 1-4. *Leistus jennei* sp.n. 1 - pronotum, 2 - mandible, 3 - penis in lateral view, 4 - apical part of penis in dorsal view (scale 1 mm).

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# LENGTH AND WEIGHT GROWTH IN *OREOCHROMIS NILOTICUS* (PISCES, CICHLIDAE) FROM GEBEL AULIA RESERVOIR AND LAKE NUBIA IN SUDAN

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**Abstract.** The data concerning the length and weight growth of the Nile Mouthbrooder *Oreochromis niloticus* (Pisces, Perciformes, Cichlidae) from the Gebel Aulia Reservoir (n = 278) and Nubia Lake (n = 19) (Sudan) in 1983-1984 and 1988-1989 are presented. The length-weight relationship, Fulton's coefficient and equation after von Bertalanffy were calculated and discussed. Knowledge concerning fish production in the Gebel Aulia Reservoir with respect to Nile Mouthbrooder are summarized.

## INTRODUCTION

The Nile mouthbrooder (*Oreochromis niloticus*) belongs to the most common fish in the White Nile with considerable economic value as food fish. Details concerning Gebel Aulia Reservoir were summarized, e. g., by P o n e d e l k o et al. (1964) and A s m a (1985). The dam on the White Nile was built in 1937. Its localisation is 45 km South of Khartoum (15°12' N, 32° 27' E), its altitude 377 m above sea - level, surface area 1246 km<sup>2</sup>, mean depth 2.3 m, capacity 3.5 x 10<sup>9</sup> m<sup>3</sup> the reservoir stretches for 500 km as a wide stripe North of Renk to the settlement of Gebel Aulia. The part of this water body which lays between the town of Renk and Kosti represents a transitional zone from the river to the reservoir. The maximum width (in the vicinity of the dam) is 6-7 km, the minimum (in the zone of the head water) is 0.8-1.0 km. Maximum rate of the current 0.4-0.5 m. sec<sup>-1</sup> was observed within the stretch from renk to Kosti. In the regions between Doeim and the dam, the river current was practically absent and it becomes visible only in the main course of the river (0.2 m. sec<sup>-1</sup>). The bank of the reservoir is rather steep, sandy, with small shallow bays, the bottom of which is covered with water plants. The east river bank is more shallow with a silty bottom. The water level of the reservoir begins to fall down in February, i.e., at the beginning of the second half of the rainless season. Then it decreases in the level until the end of May and April, at the end of September the rated stock of water gets replenished; the water level reaches its highest in the absolute mark of 377 m. The annual amplitude of the water level in this reservoir is 6.03 m. Distribution of the mean monthly air temperature and the rainfall along the White Nile is summarized in Tables 1 and 2.

Some hydrochemical data concerning Gebel Aulia Reservoir are as follows (based on studies during 1963-1964, see P o n e d e l k o, 1964): the transparency in the tail-water of the reservoir was 45-85 cm, it was 25% lower than in the head water. The content of dissolved oxygen in the

reservoir varied between 5.0-6.5 mg.l<sup>-1</sup>, the content of NO<sub>3</sub> was 0.05 mg.l<sup>-1</sup>. The weak acid reaction of water varied between pH=8.35-8.40. Later studies, in 1983-1984, at the vicinity of the dam showed that average water temperature was 25.6°C. There was a gradient of  $\pm 3.5^\circ\text{C}$  during the day, the temperature ranged from 16° to 31°C. The water acidity ranged from pH 7.4 to 8.6. The oxygen concentration was above saturation all the year round. This concentration ranged between 4.1-10.8 mg.l, the mean oxygen concentration was 6.6 mg.l<sup>-1</sup>. The water transparency ranged between 12.5-52 cm, water conductivity 160-330  $\mu\text{S.cm}^{-1}$  (Asma, 1985). The average zooplankton biomass throughout the whole reservoir was 0.192 g.m<sup>-3</sup> in November and 0.350 g.m<sup>-3</sup> in April. The biomass of benthos varied within a wide range along the length of the reservoir, the average value for the whole area of the examined reservoir was 1.075 g.m<sup>-2</sup>. The benthos was distributed not uniformly throughout the reservoir. The central and southern parts of the reservoir were richer than the pre-dam area. The dominant forms of zooplankton and zoobenthos of the Gebel Aulia Reservoir are represented mostly by species widely spread in the Palearctic which greatly prevail over endemics. The total number of registered species of fishes exceeded 100; however, the number of commercial species was comparatively limited. In the water reservoir only 77 % of the conventional net line catch was composed of 11 species (Ponedelko et al., 1964). After Adam (1986), seven families accounted for more than 95 % of the total catch. These were in order of the decreasing abundance: Mormyridae (23.7 %), Mochonidae (23.5 %), Schilbeidae (21.1 %), Characidae (13.4 %), Cyprinidae (5.8 %), Bagridae (5.2 %) and Citharinidae (2.8 %). The fish fauna in the Gebel Aulia Reservoir at the vicinity of the dam during March 1983 - August 1984 was composed of 54 fish species, 28 genera and 13 families. The most frequent species were: *Hydrocinus forskalii* (local name "Kas", 5.6 % of the total catch), *Chrysichthys auratus* (local name "Abu Reyala", 5.2 %), *Labeo horiae* (local name "Tutukum", 5.0 %), *Alestes baremose* (local name "Kawara", 4.8 %), *Eutropius niloticus* (local name "Schilbaya Arabi", 4.6 %), *Oreochromis niloticus* (local name "Bulti", 4.6 %), *Hydrocinus lineatus* (local name "Kas", 4.4 %) and *Synodontis schall* (local name) "Gargour", 4.4 %), Asma (1985). Spawning of the majority of commercial species of fish take place during the period of the water level rise, i. e., from July to October. But there are localities within the examined reservoir where spawning was prolonged or intermitted. The Gebel Aulia Reservoir is the main site for the fish supply to the capital, Khartoum. Fish is either consumed fresh (80 %), sun-dried or wet-salted for the local consumption or export. The absence of proper and adequate statistics makes the estimate of the actual fish production difficult. Consequently the reservoir represents a priority in any research programme. The present study is meant to contribute to the basic biological studies needed for better understanding of the reservoir population dynamics and hence to the potential production exploitation pattern relationship.

The estimates of present production range between 7,000-8,100 tons annually, potential production is 15,000 tons per year (Henderson, 1975). The maximum sustainable yield of fishes for the whole reservoir was estimated as 7,363,860 [t/year<sup>-1</sup>] (Asma, 1985). The total catch of *Oreochromis niloticus* on three localities on the White Nile (Kosti, Doeim and Mungah) during 1983-1987 is given in Table 3, the total catch of "*Tilapia*" compared with the catch of other fish species and per day fish catch are given in Tables 11-12.

The other reservoir, Lake Nubia, was constructed across the river Nile in 1961. This reservoir

ir lies within the Sudanese borders and extends into Egypt as Lake Naaser. The dam was constructed at Aswan in Egypt. The mean length of the lake is 430 km at 160 m a.s.l reservoir level, the mean width 7.1 km, the maximum surface area 3,057 km<sup>2</sup>, the maximum depth 110 m, the mean depth 21.6 m, the annual mean temperature at the surface 23.9°C, the water transparency 20-700 cm, pH 6.8-9.0, the conductivity range 190-300 µS. cm<sup>-1</sup>, dissolved O<sub>2</sub> at the surface 2-14 mg.l<sup>-1</sup>. Main reasons for the dam construction were production of energy for industry, irrigation, flood control, transport and fisheries. The number of fish species recorded is 55 in 17 families.

The most important species are as follows: *Oreochromis niloticus*, *Oreochromis gallilaeus* (local name "Bulti"), *Alestes nurse* (local name "Himella"), *Labeo forskalii* (local name "Debeis el hangaer" or "Massas"), *Eutropius niloticus* (local name "Shilbya arabi"), *Alestes baremose* (local name "Kawara baladi"), *Labeo niloticus* (local name "Dabeis"), *Barbus bynni* (local name "Benni"), *Hydrocynus forskalii* (local name "Kass"), *Labeo horiae* (local name "Tutkum"), *Labeo coubie* (local name "Kadan") and *Lates niloticus* (local name "Ijil"). The percentage composition of dominant fish was stated by Abu-Gideiri and Ali ("s.a.") based on their investigation covering the whole year of 1972: *Eutropius niloticus* (30.6 %), *Alestes baremose* (20.7 %), *Hydrocynus forskalii* (8.2 %), *Synodontis schall* (6.2 %), *Lates niloticus* (6.1 %), *Labeo niloticus* (6.1 %) and *Synodontis serratus* (6.1 %). For further data concerning fishes in the Lake Nubia see G e o r g e (1973). Summarized data about hydrology, geography, meteorology, morphometry, water physics water chemistry, limnobiology and fisheries are presented by E n t z (1984).

#### MATERIAL AND METHODS

Specimens for the study were seined in the following localities : Kosti, Gebel, Aulia, Reservoir, Dec. 1983 - March, 1984, n=18; Redeis, Gebel Aulia Res., March, 3, 1988, n=32; Redeis, Nov., 11, 1988, n=1, Redeis, Dec., 23, 1988, n=38; Redeis, Jan., 1989, n=38, Redeis, Febr., 16, 1989, n=20, Redeis, March, 20, 1989, n=22, Redeis, June, 4, 1989, n=8, Gebel Aulia Res., June, 20, 1989, n=39, Redeis, June, 20, n=30, Kosti, Aug., 18, 1989, n=15, Redeis, Aug., 18, 1989, n=8; Kosti, June, 14, 1989, n=18, Gebel Aulia Res., Aug., 18, 1989, n=10. Small material was obtained from the Nubia Lake, April, 16, 1989, n=15, May, 18, 1989, n=4.

In all specimens of the Nile mouthbrooder, the length of the body (BL) and total length (TL) in mm and the weight in grams were determined. The age was determined on the basis of the scale structure by the use of the projecting apparatus Documator Lesegerätt DL II (GDR), using the 17.5 times magnification. Selected scales were taken from the first or second row of scales below lateral line directly opposite to the beginning of the dorsal fin. From collected scales only one was used with clearest annuli along the ventrodiagonal radius. Body-scale relationship was found nearly linear (see Fig. 1), and therefore the method after R. L e e (1920) was used for the determination of the back-calculating length with the correction of 20 mm for the start of the scale formation. The length-weight relationship was determined using the method following R o u n s e f e l l & E v e r h a r t (1960). The Fulton's coefficient (K) was calculated after the common by used formula :

$$K = \frac{W \cdot 10^4}{L^3}$$

where W is total Weight of captured specimen (in g) and L is its body length (in mm). The back-calculated body lengths were used for the construction of the growth equation according to von Bertalanffy (R i c k e r, 1975)

#### RESULTS AND DISCUSSION

The number of 297 specimens of the age groups 0-6 were used for the study, originating from the Gebel Aulia Reservoir and Lake Nubia. Due to the small number of specimens collected in

Table 1. The distribution of mean monthly air temperature (°C at 8 a.m. Sudan time) and extreme monthly air temperature along the White Nile (Ponedelko et al., 1964). For the Renk ave. from 24 years, Kosti from 23 years and Gebel Aulia from 17 years

locality	Renk			Kosti			Gebel Aulia		
month	ave.	mean max.	mean min.	ave.	mean max.	mean min.	ave	mean max.	mean min.
January	20.6	33.9	14.9	19.8	33.0	16.7	18.8	31.4	15.6
February	22.2	35.7	16.4	21.0	34.6	17.5	20.4	33.1	16.3
March	29.4	38.8	19.1	25.0	38.0	19.9	24.1	36.4	18.9
April	29.9	40.1	22.6	28.9	40.4	22.6	28.9	39.6	22.2
May	29.4	38.3	24.1	29.9	40.1	24.8	31.3	41.0	25.6
June	26.8	35.2	23.0	28.3	37.9	24.9	30.8	40.6	22.6
July	25.0	32.5	22.0	25.7	34.3	23.3	28.3	36.9	25.4
August	24.5	31.1	20.5	24.8	32.2	22.5	27.2	34.4	24.7
September	25.2	32.5	20.2	25.6	34.2	22.5	28.5	36.4	25.4
October	26.5	35.7	20.6	27.5	37.4	23.0	29.9	38.4	25.2
November	25.6	36.5	18.0	25.6	36.5	21.1	24.8	34.6	20.6
December	22.4	34.3	15.0	21.5	39.5	17.9	21.1	32.0	17.2
ave.annual	25.4	35.4	19.8	24.8	36.0	21.4	26.2	36.3	22.0
highest max. for the period		47.8			45.3			46.0	
lowest min. for the period			8.1			10.1			8.0

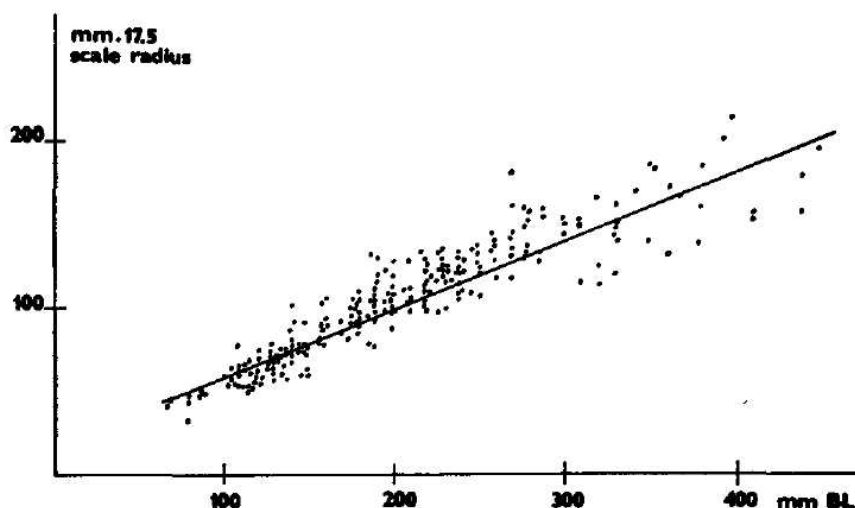


Fig. 1. The relationship between body length and ventro-diagonal scale radius in *Oreochromis niloticus*. Body length (in mm) along abscissa, ventro-diagonal scale radius (in mm, magnified 17.5) along ordinate.

single localities (Kosti, Redeis) within the Gebel Aulia Reservoir, a detailed study of the difference in the length growth relationship between places studied has not have been possible. The relationship between the body length and the index  $TL/BL$  is summarised in the Table 4. It is

Table 2. The distribution of rainfall along the White Nile (1931 - 1960) after Meteorological service of the Republic of the Sudan (after Ponedelko et al, 1964)

month	total rainfall for month												total for year (mm)	period with a total of 10 mm	total for the period July to August (mm)	total for the year	% of rain fall during July-August in the total of the year
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII					
meteorological station																	
Renk	-	-	-	3	31	76	128	145	95	45	3	-	526	Nov.-Apr.	273	52	
Kosti	1	-	1	4	18	47	111	143	60	22	1	-	406	Nov.- Apr.	254	62	
Gebel Aulia	-	-	-	1	5	18	57	86	30	7	-	-	204	Oct.-May	143	70	

Table 3. The number and weight of the Nile mouthbrooder caught at the specific time and the localization on the White Nile

locality	year	total no. of fish	total weight (kg)	ave. weight of one specimen (kg)	observation
Kosti	1984	104 000	32 731	0.31	4 months (Sept., Oct., Nov., Dec.)
	1985	371 960	120 138	0.32	11 months (except Oct.)
	1986	674 189	210 835	0.31	11 months (except June)
	1987	270 617	83 321	0.31	6 months (Jan., Febr., May, Apr., July, Aug.)
Doeim	1985	271 222	91 466	0.34	4 months (Sept., Oct., Nov., Dec.)
	1986	301 094	141 001	0.47	5 months (May, July Oct., Nov., Dec.)
Mungra	1983	33 624	24 748	0.74	6 months (July, Aug., Sept., Oct., Nov., Dec.)
	1984	54 242	27 441	0.51	11 months (except Dec.)
	1985	336 989	114 498	0.34	7 months (March, Apr., June, July, Aug., Sept., Oct., Nov.)
	1986	461 214	97 893	0.21	10 months (except Apr., June)
	1987	117 460	30 195	0.26	5 months (Jan., Febr., Apr., May, Oct.)
total	1983-87	2 996	791 974	267	0.37 (ave.)

evident that this index ranges from 1.19 to 1.24 on average and it is not distinctly increasing or decreasing with the growth of the body. Table 7 brings the average length growth in single age groups (0-6) in the Gebel Aulia Reservoir. We have found an evident variability in the length growth, e.g., the body length of specimens in the age 1 group has the range of 55-182 mm (see Tab. 7). This is probably due to the potency of the repeated breeding of the Nile mouthbrooder within one year. The variability expressed using the standard error of the mean and the standard deviation was mostly increasing with the age in the first years of life. The back-calculated length



Table 4. The relationship between the body length and the index of TL/BL (TL - total length in mm, BL-body length in mm, s- standard deviation,  $s_x$  - standard error of the mean, n - number of specimens) in all examined specimens of *Oreochromis niloticus*

n	length group	ave. body length	ave. value of index TL/BL	s	$s_x$
50	61-130	111	1.22	0.06	0.009
70	131-180	155	1.24	0.04	0.005
93	181-230	210	1.20	0.03	0.003
46	231-280	256	1.19	0.04	0.006
18	281-330	312	1.24	0.07	0.017
1	331-380	363	1.21	0.05	0.015
5	381-430	400	1.23	0.05	0.023
3	431-480	443	1.21	0.05	0.026

Table 5. The back calculated length growth of the Nile mouthbrooder from the locality Kosti (Gebel Aulia Reservoir) in 1983-1989

age	n	TL (mm)	BL (mm)	W (g)	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>
0+	1	135	112	30			
1+	14	157	130	74	100		
2+	31	255	217	303	117	196	
3+	1	320	240	450	109	172	229
ave.	47	217	175	214	109	184	229
min.	113	103	20	67	99	-	
max.	340	285	650	152	249	-	

Table 6. The back calculated length growth of the Nile mouthbrooder in the locality Redeis (Gebel Aulia Reservoir) during 1988-1989

age	n	TL (mm)	BL (mm)	W (g)	l <sub>1</sub>	l <sub>2</sub>	l <sub>3</sub>	l <sub>4</sub>	l <sub>5</sub>
0+	1	175	132	76					
1+	127	231	191	271	119				
2+	15	273	230	397	111	175			
3+	11	350	281	812	112	188	237		
4+	6	418	357	1283	125	189	271	333	
5+	1	420	360	1450	178	233	283	322	352
ave.	161	311	259	715	129	196	264	328	352
min.		140	120	76	79	108	144	308	-
max.		460	390	1800	182	386	329	353	-

growth of the Nile mouthbrooder from localities Kosti and Redeis is given in Tables 5 and 6, in the Gebel Aulia Reservoir in Table 7. The average back-calculated length growth of the Nile mouthbrooder in all specimens from the Gebel Aulia Reservoir (n=298) was calculated as follows (in mm): l<sub>1</sub> - 116, l<sub>2</sub> - 194, l<sub>3</sub> - 260, l<sub>4</sub> - 319, l<sub>5</sub> - 360, l<sub>6</sub> - 371. The average length growth

Table 7. The back-calculated average length growth within all examined material of the Nile mouthbrooder from the Gebel Aulia Reservoir in 1983-1989 ( $s_x$  - standard deviation,  $s_x$  - standard error of the mean)

age	n	TL (mm)	BL (mm)	W (g)	11	12	13	14	15	16
0+	4	131	104	48						
1+	178	210	174	214	113					
$s_x$					22.46					
2+	64	263	220	340	111	187				
$s_x$					1.68					
3+	19	325	263	622	24.52	41.95				
$s_x$					3.06	5.24				
4+	9	392	331	1017	101	177	227			
$s_x$					24.47	60.95	44.70			
5+	2	450	380	1575	5.61	13.98	10.26			
$s_x$					114	177	250	308		
6+	2	460	385	1718	32.33	32.25	36.63	39.60		
$s_x$					10.78	10.75	12.21	13.20		
ave.	278	319	265	791	142	216	282	326	326	
min.		85	68	15	114	215	280	322	356	371
max.		480	400	2160	182	288	329	353	376	374
$s_x$					23.72	45.19	43.00	33.61	11.15	4.24
$s_x$					1.43	4.46	7.60	9.32	5.57	3.00

in Lake Nubia ( $n=19$ ) was:  $l_1$  - 125,  $l_2$  - 227,  $l_3$  - 321,  $l_4$  - 385,  $l_5$  - 412,  $l_6$  - 431 mm. The average length growth in both localities was better in all years of life than in Lake Tschad (see Freyer & Iles, 1972).

After calculating the parameters of von Bertalanffy's growth model concerning the Gebel Aulia Reservoir, we have received the following curve of the numerical equation :

$$l_t = 450 (1 - e^{-0.2949(t - 0.0109)})$$

Maximum difference between values calculated by the use of the above-mentioned equation and average values of the length growth (see Tab. 7) was 13 mm. The theoretically attainable maximum length ( $L_{\infty} = 450$  mm BL) is identical with the largest specimen captured.

Boulenger (1915) noted the largest specimen of *Oreochromis niloticus* in the size of 460 mm, Welcomme (1967) has found the maximum size of 410 mm and Mahdi, Rafail & Al-Kholly (1973) cited the maximum size of 550 mm. The length-weight relation ascertained for the Nile mouthbrooder from the Gebel Aulia Reservoir in 1983-1989 was :

$$\log_w = -4.58213 + 3.03557 \log l$$

Mahdi Rafail & Al-Kholly (1973) calculated analogous equation as  $\log_w = -4.9032 + 3.1483 \log l$  ( $n = 869$ , 255-455 mm, 446-3080 g). These authors analysed the length growth of the Nile mouthbrooder using only the age determination by scales and measuring the length of captured specimens.

A very broad variability was found in the examined material as regards Fulton's coefficient (1.37-8.74). The average value was not dependent on the length of examined specimens (see

Tab. 9). A more conspicuous fluctuation of this coefficient was ascertained when the examined material was divided into groups obtained in different months.

Table 8. The back calculated length growth of the Nile mouthbrooder in the Lake Nubia during 1989

age	n	TL (mm)	BL (mm)	W (g)	11	12	13	14	15	16
2+	9	430	337	1606	117	249				
3+	7	457	356	2000	107	212	324			
4+	1	550	440	2900	139	213	343	399		
6+	2	530	445	3700	138	232	296	370	412	431
ave.	19	492	395	2552	125	227	331	385	412	431
min.		350	280	800	72	149	253	343	407	428
max.		550	450	4000	170	301	372	399	416	434

Table 9. The relationship between the body length and the Fulton's coefficient in the examined material of the Nile mouthbrooder

n	length group (mm)	BL (mm)	ave. value of Fulton's coefficient	s	s-x
48	61 - 130	111	3.26	1.32	0.19
72	131 - 180	155	3.23	0.73	0.09
93	181 - 230	210	3.38	0.82	0.09
48	231 - 280	256	2.97	0.99	0.14
17	281 - 330	312	3.79	1.00	0.24
11	331 - 380	363	3.17	0.62	0.19
5	381 - 430	400	3.44	0.73	0.32
3	431 - 480	443	3.94	0.50	0.29

Table 10. The Table showing the difference of the Fulton's coefficient in different months of the Nile mouthbrooder (all examined material)

month	n	ave. value of Fulton's coefficient	s	s-x
January	21	3.41	0.77	0.17
February	54	4.03	0.64	0.09
March	16	3.89	0.70	0.18
April	5	4.35	0.88	0.39
May	8	2.18	0.63	0.22
June	88	3.14	1.03	0.11
August	49	2.65	0.40	0.06
November	12	3.29	0.36	0.11
December	44	2.97	0.62	0.09

Table 11. The total catch of "Tilapia" (*Tilapia gallilaea*, *Tilapia zillii* and *Oreochromis niloticus*) compared with catch of other fish species from the same localities (Kosti, Redeis) during 1978-1981 (after Fisheries Statistic Section, Fisheries Administration, Khartoum)

year	"Tilapia" species no. of sp./weight in kg	other species	in %
1978	276 929 418 636	1 083 036 786 948	25.6 53.2
1979	496 643 308 218	1 420 819 943 397	34.9 32.7
1980	140 229 142 657	641 492 542 319	21.9 26.3
1981	193 446 196 232	1 801 453 873 203	10.7 22.5

In our own material from the Gebel Aulia Reservoir age groups 1+ (64 %) and 2+ (23 %) were prevalent, while the prevalent age groups IV (36 %), III (31 %) and II (26 %) were found by Mahdi, Rafail & Al-Kholy (1973). These differences are probably caused by different methods of catching. The average weight of specimens caught on three localities (Kosti, Doeim and Mungra) within the area of the Gebel Aulia Reservoir was 0.37 kg. It seems justified to say that the age of such average fish is 2-3 years. When we compare the back-calculated average length growth from two localities in the Gebel Aulia Reservoir, Kosti and Redeis, the statistical difference using C.D. coefficient is not found. The same results were obtained

Table 12. The total per day fish catch during May 1975 at Kosti after data of Fisheries Research Centre, Khartoum "Tilapia" (*Tilapia gallilaea*, *Tilapia zillii* and *Oreochromis niloticus*)

date	number of specimens, "Tilapia" only	total weight in kg, "Tilapia" only	number of specimens, "Tilapia" and others species together	total weight, "Tilapia" and others species together
11.5.1975	1195	727	3205	1581
12.5.1975	2305	1282	3159	2725
13.5.1975	2401	1269	2663	2358
14.5.1975	5180	1782	7175	3565
15.5.1975	2960	1062	3413	1853
16.5.1975	1977	6391	2369	6767
17.5.1975	653	324	1048	780
18.5.1975	3060	1270	3881	22 591
19.5.1975	6200	2766	66 705	3045
20.5.1975	3360	1498	3888	2157
21.5.1975	3650	1325	3945	3723

when we have compared the average length growth in the Gebel Aulia Reservoir and Lake Nubia. In our opinion, however more numerous material composed from all groups is necessary for a detailed growth analysis in the different localities.

## SUMMARY

The growth of the Nile mouthbrooder, *Oreochromis niloticus* ( $n = 297$ , age from 0+ to 6+, ranges of the BL 68-450) in the Gebel Aulia Reservoir and Lake Nubia in 1983-1989 was studied using the scale method after R. Lee (1920). In the Gebel Aulia Reservoir, the average back-calculated length growth, using von Bertalanffy's equation, was as follows ( $n = 276$ ):  $L_{\infty} = 450$ ,  $K = 0.2949$ ,  $t_0 = 0.0109$ . The parameters of the body length-weight equation were calculated as:  $a = -4.58213$  and  $b = 3.03575$ . Fulton's coefficient ranged from 1.37 upto 8.74, its highest average value being found in specimens caught in April (4.35); the lowest value was found in May (2.18).

The average length growth in Lake Nubia (only 19 specimens) was  $l_1 - 125$ ,  $l_2 - 227$ ,  $l_3 - 321$ ,  $l_4 - 385$ ,  $l_5 - 412$ ,  $l_6 - 431$  mm of the body length.

The average weight of specimens caught using seining near the localities of Kosti, Doeim and Mungra (the Gebel Aulia Reservoir) in 1983-1987 was 0.37 kg with the corresponding age of 2-3 years. The average yield of the biomass of *Oreochromis niloticus* near Kosti was 112 tons per year, near Doeim 116 tons per year and near Mungra 59 tons per year.

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**GEOGRAPHIC DIFFERENTIATION OF POPULATIONS OF NEBRIA (ALPAEUS)  
TATRICA (COL., CARABIDAE, NEBRIINI)**

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**Abstract.** *Nebria (Alpaeus) tatica*, an endemic species of the West (Central) Carpathians, lives isolated in the alpine and intercalary zones of the highest mountains of this range. Four subspecies have been recognized: *N. t. tatica* Miller, *N. t. dumbirensis* Pulpán, *N. t. fatrensis* subsp. n. and *N. t. komareki* subsp. n. The new subspecies are described, all subspecies are illustrated and keyed. Notes on the bionomics and reproduction cycle of *N. t. tatica* are given.

The species *Nebria tatica* was described by Miller (1859) from Západní Tatry (the West Tatra Mts.). Miller comments upon its distribution as follows: "Am ganzen Tatra-Gebirge namentlich auf der Alpe Placlivo, an Schneerändern in einer Höhe von 5000 - 6000 Fuss".

At present, the populations of *Nebria tatica* are known from much larger territory. They have been found in the peak region of the mount Pilsko, in the Malá Fatra Mts., in the Velká Fatra Mts., in the Velký Choč Mts., in the Západní, Vysoké, Belanské and Nízké Tatry Mts. and in the forest region of the mount Kojšovská hora in the easternmost part of the Slovenské rudohorie Mts. (Fig. 1). The investigation of the material from the localities given shows that the populations living isolated in the separate Westcarpathian mountains are different. As early as in 1957 Pulpán described *N. t. dumbirensis* (as a variety) from the region of the mount Ďumbier in the Nízké Tatry Mts. In 1958 Pulpán differentiated this taxon from *N. t. tatica* also pictorially. The more extensive material from the Velká Fatra Mts. indicates that here, too, morphologically distinguishable population can be found. Last but not least, the surprising find of single male of *N. tatica* in the easternmost part of the Slovenské rudohorie Mts. resulted in the distinction of the fourth subspecies of this species.

**MATERIAL**

This study is based on the examination of over 1100 *N. tatica* specimens. 20 specimens (10 males, 10 females) of *N. t. tatica*, of *N. t. dumbirensis*, of *N. t. fatrensis* subsp. n., each, and all specimens of the sporadically occurring populations being at hand have been measured to obtain the characters based on morphometric ratios.

We would like to thank colleagues P. Bulirsch, Ing R. Businský, Dr J. Hejkal and Ing J. Janák for their generous loans of specimens from the mount Pilsko, the Velký Choč Mts. and the Malá and Velká Fatra Mts.



#### DIAGNOSTIC CHARACTERS OF *NEBRIA* (*ALPAEUS*) *TATRICA* MILLER

Colour and microsculpture. Dark brown to red brown, more or less shiny, head with wide red spot; antennae, palpi and legs yellow red to red. Head and pronotum with isodiametric like meshes, microsculpture of elytra transverse.

Antennomere I with 1 dorsal, antennomere II with 1 ventral seta. Pronotum markedly cordate (Fig. 7), basal angles acute, projected posteriorly; (1)-2-3-(4) lateral setae and 1 seta in basal angles. Elytra extremely elongate ovate, humeral tooth more or less distinct, basal border of elytra slightly curved, forming with lateral border an obtuse angle; striae moderately deep, interval 3 with 1-7 (regularly with 4) setiferous pores, interval 5 exceptionally with 1 setiferous pore asymmetrically, scutellar pores absent, rarely 1 pore present asymmetrically; hindwing vestigial; third to fifth visible abdominal sterna with 1-5 posterior paramedial setae on each side. Aedeagus as in Fig. 8.

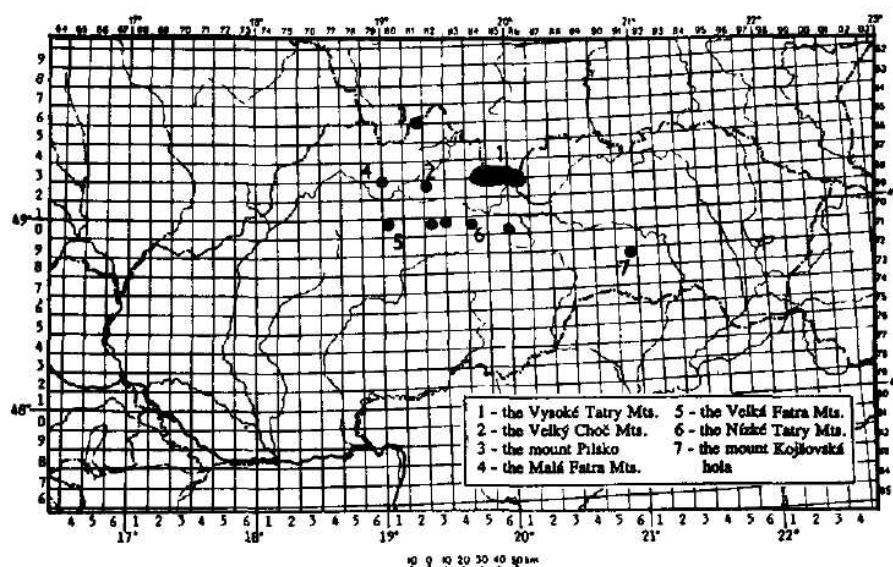


Fig. 1. Map of Slovakia with the finding places of *Nebria* (*Alpaeus*) *tatica* Miller.

#### DIFFERENTIAL CHARACTERS OF POPULATIONS OF *N. TATRICA* MILLER

Shape of pronotum. The maximum width/length taken along the median longitudinal groove ratio varies only slightly in all populations examined, from 1.34 to 1.49; the narrowest pronotum appears in the populations from the Západní, Vysoké and Belanské Tatry Mts. (mean 1.40) and from the Velký Choč Mts. (mean 1.41); the widest pronotum has been found in the populations from the Malá Fatra Mts. (mean 1.46) and the Velká Fatra Mts. (mean 1.44) (the single male from the mount Kojšovská hola has also a very wide pronotum - 1.47), the population inhabiting

the Nízké Tatry Mts. shows the mean ratio of 1.42. The differences, however, exist in the length and shape of the basal angles of pronotum. The shortest basal angles are presented in the populations from the Západní, Vysoké and Belanské Tatry Mts., their length assumes only 3.1 to 5.7 p.c. of the maximum length of pronotum, mean in 20 spec. 4.5 p.c.; basal angles only very slightly projected laterally. Relatively short basal angles can be seen also in the specimens from the Velký Choč Mts. (3.6-7.9 p.c., mean 6.6 p.c.) as well as in the female from the mount Pilsko (6.2 p.c.); all four specimens from the Velký Choč Mts. present laterally projected basal angles (Figs 3, 4). The populations from the Nízké Tatry Mts., the Velká Fatra Mts. and the Malá Fatra Mts. show much longer and more markedly projected basal angles (N. Tatry Mts.: 6.1-9.3, mean in 20 spec. 7.5 p.c.; V. Fatra Mts.: 4.6-9.0 p.c., mean in 20 spec. 7.5 p.c.; M. Fatra Mts.: 7.7-9.0 p.c., mean in 3 spec. 8.2 p.c.). The male from the mount Kojšovská hora possesses also long basal angles occupying 7.6 p.c. of the maximum length of pronotum.

The differences between the populations exist also in the depth and the punctuation of the elytral striae. The populations inhabiting the Belanské, Vysoké and Západní Tatry Mts. and the Velký Choč Mts. present shallow, obsoletely punctuate to glabrous striae; intervals are flat; elytral microsculpture is impressed, therefore elytrae are dull. The population living in the Nízké Tatry Mts. has more deeply impressed, densely and distinctly punctuate elytral striae; intervals are more convex; elytral microsculpture is fine, therefore elytrae are shinier. The population from the V. Fatra Mts. presents moderately impressed, more sparse and finer punctuate elytral striae than the population from the Nízké Tatry Mts. Three examined specimens from the Malá Fatra Mts. show more finely punctuate and more shallowly impressed elytral striae and therefore intervals are flatter than in the population from the Velká Fatra Mts. The microsculpture appears in the specimens from the both Fatras a little more conspicuous than in the populations from the Západní, Vysoké and Belanské Tatry Mts.

The differences exist also in the length/width ratio of the ultimate maxillary palpomere. The maximum length/the maximum width ratio of this palpomere fluctuates in 70 measured specimens from 2.60 to 3.90. It is the lowest in four specimens from the Velký Choč Mts. (2.60-3.05, mean 2.85), in 20 specimens from the Západní, Vysoké and Belanské Tatry Mts. (2.70-3.30, mean 3.05) and in the female from the mount Pilsko (3.15). It is evidently the highest in 20 spec. from the Nízké Tatry Mts. (3.30-3.90, mean 3.55), the same value of the ratio is also shown in the male from the mount Kojšovská hora (3.50). 20 specimens from the Velká Fatra Mts. have the ultimate maxillary palpomere rather short (ratio 2.95-3.40, mean 3.15), three specimens from the Malá Fatra Mts. only slightly longer (3.15-3.50, mean 3.30).

The analysis of differences in the characters given shows that the examined populations of *N. tatrica* in the individual mountain ranges have lived in a long-termed isolation and formed certain subspecific distinctions; often in the geographically independent combinations of characters. A tendency is perceptible only in the form of elytral striae, from almost glabrous and shallow ones in the Západní, Vysoké and Belanské Tatry Mts. and in the Velký Choč Mts. over more impressed and finely punctuate in the populations from both the Fatras up to impressed and markedly punctuate in the population of the Nízké Tatry Mts. The dependence of body length on the altitude is also evident.

Taking into account primarily the scope of the material, we distinguish the following four subspecies:

- 1 (2) Humeral tooth and humeri distinct (Fig. 14); elytra shorter and wider (Fig. 12); 10.5 mm; the Slovenské rudohorie Mts., mount Kojšovská hora. .... *N. (A.) t. komareki* subsp. n.
- 2 (1) Humeral tooth and humeri little distinct (Fig. 16) or indistinct (Fig. 15, 17); elytra longer and narrower (Fig. 13).
- 3 (4) Ultimate maxillary palpomere elongate, length/width ratio exceptionally lower than 3.40 (Fig. 9); elytral striae impressed, distinctly and densely punctate, intervals convex, shiny; basal angles of pronotum markedly projected (Fig. 5); 9.0-10.6 (mean, 9.9) mm; the Nízke Tatry Mts. .... *N. (A.) t. dumbirensis* Pulpán
- 4 (3) Ultimate maxillary palpomere shorter, club- or long hatched-like, length/width ratio regularly lower than 3.40 (Figs 10, 11); elytral striae more shallow, more finely punctate or almost glabrous, intervals flatter, duller; basal angles of pronotum of different length.
- 5 (6) Elytral striae shallow, almost glabrous, intervals flat; pronotum narrower, basal angles short, occupying at most 6 p.c. of the maximum length of pronotum (Fig. 2). Smaller and slender, 8.8-10.7 (mean, 9.6) mm. The Západní, Vysoké and Belanské Tatry Mts. .... *N. (A.) t. tatrica* Miller
- 6 (5) Elytral striae more impressed, finely punctate, intervals more convex; pronotum wider, basal angles longer, occupying as much as 9 p.c. of the maximum length of pronotum (Fig. 7). Greater and more robust, 9.5-11.0 (mean, 10.3) mm. The Velká Fatra Mts. .... *N. (A.) t. fatrensis* subsp. n.

*Nebria (Alpaeus) tatrica tatrica* Miller, 1859 (Figs. 2, 10, 15)

*Nebria tatrica* Miller, 1859, Wiener Entomol. Monatschrift, 3:304.

Distributed in the alpine zone of the Západní (West), Vysoké (High) and Belanské (Belanian) Tatry (Tatra) Mts. It lives on the border of moraines, on the rock debris slopes, at the edge of snow patches, on the shore of the glacial lakes, in the peak region and on the ridges of mountains under stones, above all on the northern slopes. Occurrence on elevations from 1500 to 2500 m, in the period May-September (most frequently in June). Mating was observed in May, the peak occurrence of teneral adults in August and September. Larval findings: first instar August (1), September (3), second instar September (2). Consequently, a two-year development cycle.

The population from the Velký Choč Mts. can be probably ranged within the nominotypical subspecies. It is noted for the basal angles of pronotum markedly projected postero-laterally (Figs 3, 4) and, regarding the lower altitude of its habitat, for the larger body length (9.7-10.8, mean 10.2 mm). We have examined only two males and two females found on June 6, 1982, at the altitude of 1300-1400 m, leg. et coll. J. Janák.

A single female found by P. Bulirsch on July 6, 1987 in the peak region of the mount Pilsko, representing the northernmost finding place of the species (Fig. 1), resembles also the nominotypical subspecies.

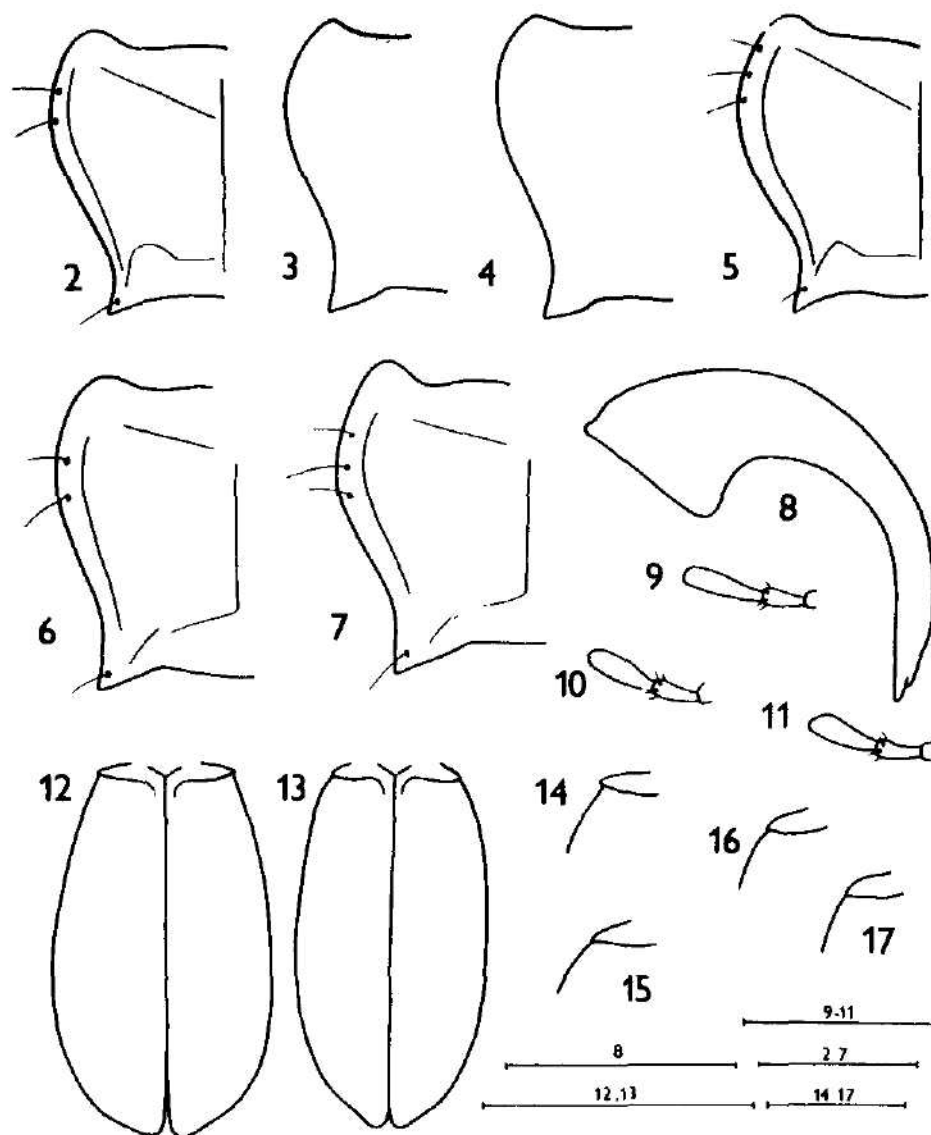
*Nebria (Alpaeus) tatrica dumbirensis* Pulpán, 1957 (Figs. 5, 9, 13, 16)

*Nebria tatrica* Mill. v. *dumbirensis* Pulpán, 1957, Musejní Zprávy Pražského Kraje, 2: 121.

*Nebria tatrica* Mill. v. *dumbirensis*; Pulpán, 1958, Musejní Zprávy Pražského Kraje, 3: 120, Fig. A.

The holotype (monotype), a male, is labeled: Slov. c. Ďumbier / 13.7.1948, leg. Pulpán / N. Tatry - 2040 m, vrchol pod kamenitou sutí, vlhko / *N. tatrica* Mill. v. *dumbirensis* Pulp., det. Pulpán, vel. 9.4 mm / Type; in collection Pulpán.

The subspecies occurs in the alpine zone of the main ridge of the Nízke Tatry Mts. (1600-2040 m, mount Chabenec / Roubal, 1923; m. Chopok, m. Ďumbier; m. Homolka / Reitter, 1870; m. Kráľova hora) in analogical habitats as the nominotypical subspecies; peak occurrence in May.



Figs. 2-17. Pronotum: 2 - *N. t. tatrica* (the Vysoké Tatry Mts.), 3, 4 - *N. tatica* from the Velký Choč Mts., 5 - *N. t. dumbirensis* (m. Ďumbier), 6 - *N. t. komareki* subsp. n. (m. Koššovská hora), 7 - *N. t. fatrensis* subsp. n. (the Velká Fatra Mts.); 8 - aedeagus of *N. tatica* (the Velký Choč Mts.); 9 - 11 ultimate and penultimate maxillary palpomeres: 9 - *N. t. dumbirensis* (m. Ďumbier), 10 - *N. t. tatrica* (the V. Tatry Mts.), 11 - *N. t. fatrensis* subsp. n. (the V. Fatra Mts.); 12 - 13 elytra: 12 - *N. t. komareki* subsp. n., 13 - *N. t. dumbirensis*; 14 - 17 humeral tooth and humeri: 14 - *N. t. komareki* subsp. n., 15 - *N. t. tatrica* (the V. Tatry Mts.), 16 - *N. t. dumbirensis* (m. Ďumbier), 17 - *N. tatica* from the V. Choč Mts. Scales  $\frac{1}{2}$  mm, only for 12, 13 = 5 mm.

*Nebria (Alpaeus) tatrica fatrensis* subsp. n. (Figs. 7, 11)

**Description:** Ultimate maxillary palpomere long hatched-like, ratio length/width = 2.95-3.40, mean, 3.15 (Fig. 11); pronotum wide, mean ratio maximum width/length taken along the median longitudinal groove = 1.44; basal angles of pronotum markedly projected, occupying 4.6-9.0 p.c., mean 7.5 p.c. of the maximum length of pronotum (Fig. 7); humeral tooth and humeri only slightly distinct; elytral striae moderately impressed, finely punctuate, intervals moderately convex; body length 9.5-11.0, mean 10.3 mm.

**Holotype:** a male, Slov. Velká Fatra, Čierný kameň, 1400-1450 m, VI.-IX. 1986, R. Businský leg. in collectio Hürka. **Paratypes:** 20 (10 males, 10 females), same data as holotype, deposited in coll. Hürka, Pulpán; National Museum Praha.

**Differential diagnosis in the key.**

**Name derivation:** this subspecies is named for the Velká Fatra Mts.

**Type locality:** the mount Čierný kameň in the Velká Fatra Mts. Beetles have been found in the intercalary zone, above all in the ground depressions where the rests of snow outstay for a long time.

As early as in the last century (Frivaldský, 1874) sporadic findings of *N. tatrica* has been reported from the intercalary and alpine zones of the Malá Fatra Mts. (mount Malý Kriváň, mount Velký Kriváň, the ridge Chleb-Stoh-Rozsutec). We have studied only one male (body length 10.6 mm) and two females (11.0, 11.2 mm) from the mount Velký Kriváň. In general, these specimens agree with those of the population from the Velká Fatra Mts., only the elytral striae are a little shallower and more finely punctuate and the intervals are flatter. Nevertheless, the specimens are slightly wider and greater.

*Nebria (Alpaeus) tatrica komareki* subsp. n. (Figs. 6, 12, 14)

**Description:** Ultimate maxillary palpomere elongate, length/width ratio = 3.50; pronotum very wide, the maximum width/length taken along the median longitudinal groove ratio = 1.47; basal angles of pronotum long, occupying 7.6 p. c. of the maximum length of pronotum (Fig. 6); humeral tooth and humeri distinct (Fig. 14); elytra shorter and wider (Fig. 12), elytral striae shallow only indistinctly punctuate, intervals wide, flat; body length 10.5 mm.

**Holotype:** a male, Slovenské rudohorie, Kojšov, Kobuldzesef, 900 m, 20. 6. 1980, J. Komárek leg. in collectio Pulpán.

**Differential diagnosis in the key.**

**Name derivation:** this subspecies is dedicated to its collector, late Josef Komárek.

**Type locality:** Slovenské rudohorie Mts., mount Kojšovská hora. The single male has been found in a stony seepage of beech wood, in full shade, on the finding place of *Duvalius bokori valyianus* (Bokor).

NOTE

*Nebria tatrica* is an endemic cryobiont inhabiting almost exclusively the alpine and intercalary zones of the western (central) Carpathians. Contemporary populations live, owing to the special microclimatic demands and the almost full reduction of wings, isolated islet-like on the highest ridges of this mountain range. The high degree of isolation, lasting about 10,000 years, caused the evolution of the local subspecies (races). Taking into account the scope of material

and the extremity of habitat we have recognized four races. Also the remaining known populations (from the Malá Fatra Mts., the Velký Choč Mts., the mount Pilsko) possess some different characters, but due to the limited number of specimens found it is not possible to appreciate the constancy of these characters. An intensive investigation, primarily in the late spring months (May, June), will probably bring new finds of other populations of this species, or to the augmentation of the number of specimens of sporadically occurring populations. However, when collecting new material it is necessary to protect habitats of *N. tatrica* with regard to its rare occurrence.

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### BOOK REVIEW

Barnard C. J. & J. M. Behnke (editors): *Parasitism and Host Behaviour*. London, New York, Philadelphia: Taylor and Francis, 1990 332 pp. Cloth Price Lstg 45.00 / US Dollars 90.00.

This volume presents a team work of 13 contributors and consists of 10 chapters. It brings together recent work across the disciplines of parasitology and behavioural ecology which reveals a fundamental role of parasitism in the evolution of behaviour patterns, morphology and population dynamics. The first chapter reviews some of the ways in which host behaviour is exploited in producer-scrounger relationships, the reproduction and mortality costs imposed on hosts and parasites. Pathology and host behaviour is examined in the next chapter considering three main categories: organ malfunction, impaired nutrition and modulation of the neuroendocrine system. Following three chapters deal with physiological alterations during parasitism and their effects on host behaviour, decision-making and evolution of sexual behaviour. In chapter 6 opportunism in parasite life cycles in relation to transmission and reproduction is looked at. Chapter 7 deals with phylogenetic perspective on the evolution of altered host behaviours and with the manipulation hypothesis. Following two chapters discuss epidemiological aspects of human helminth infections considering human behaviour in relation to transmission of trichinosis, hydatid disease, schistosomiasis and some soil-mediated helminthiases. The volume concludes with influence of host behaviour on some ectoparasites of birds and mammals.

This book traverses the phylogenetic scale from protozoa, helminths and arthropods to various animal hosts and human cultural traditions. The study of host-parasite behavioural relationships represent an interdisciplinary scientific field which attracts the attention of parasitologists, behavioural ecologists, evolutionary biologists and epidemiologists, and results in improved control measures of many harmful parasites.

J. Jira

**A CHECK LIST OF SCORPIONS (ARACHNIDA: SCORPIONES)  
IN THE COLLECTIONS OF THE ZOOLOGICAL DEPARTMENT,  
NATIONAL MUSEUM IN PRAGUE**

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**A b s t r a c t.** 1360 specimens of scorpions of all families, collected by naturalist and travellers in all continents during the last 150 years, are deposited in the National Museum in Prague. This material, consisting of 94 species, 44 genera and 9 families, is revised and listed.

**HISTORY OF THE COLLECTION.**

The first reference to scorpions deposited in the National Museum is in a catalogue of the insect collection drawn up by F.K.Prach (1839-1863) at the beginning of 1861. He listed 22 specimens. The collection grew thanks to contributions of various travellers and patrons of the Museum. Dr K.Táborský (1906-1988) intended to revise the collection [he mentioned this in a paper on the geographic distribution of the genus *Buthus* (1934)], but he never carried out the plan. In this paper, T á b o r s k ý mentioned 17 species of scorpions classified in the genus *Buthus* at that time and in the subfamily Buthinae at present.

The oldest of the scorpion collections in the National Museum is that of L.Salvator who collected the material between 1880s and the first few years after 1900. According to T á b o r s k ý (1934), all scorpions that he saw in this collection came from Tunisia, and Bizerta had been given with some of them as the locality. This collection also includes material from Greece (*Mesobuthus gibbosus* and *Androctonus crassicauda*).

In 1958, J.Frič donated a commercial museum [established by V.Frič (1839-1916) in 1862] to the National Museum in Prague. Most of the scorpions of the genera *Pandinus* and *Heterometrus* come from this source. However, the localities where the individual specimens were collected are not sufficiently specified.

The Museum collection also includes scorpions collected by Dr E.Holub (1847-1902), E.S.Vráz (1860-1933), J.Kořenský (1847-1938) and B.Machulka (1875-1954). Prof Machulka made several journeys to Africa after 1911.

The largest contribution was made by a Czech physician Dr V.Kálalová - di Lotti (1896-1971) who worked in Baghdad and sent insect material to Prague between 1929 and 1932. Surprising is the number of specimens which she collected - for example, 187 scorpions of the dominant species *Compsobuthus matthiesseni*.

Dr J.Baum (1900-1944), an arachnologist, donated interesting material from Australia, West Africa and Spain.

With a few exceptions, all scorpions acquired after World War II, including material from entomological expeditions to Iran in 1970, 1973 and 1977, were collected by staff members of the Museum (H o b e r l a n d t, 1981 and 1983).

#### MATERIALS AND METHODS

I revised the collection in the National Museum in 1990-1991, identified the majority of specimens and verified identifications made by Dr Táborský in the 1930s. Most of the specimens are preserved in alcohol, 371 scorpions are preserved dry, but many are damaged.

#### Explanatory notes

Arabic numeral - the number of specimens

A - specimens preserved in 75 % alcohol

E - mounted dry specimens

b - specimens born and reared in captivity. Locality and date indicate the origins of scorpions which founded the laboratory colony.

#### RESULTS

**Bothriuridae** Simon, 1880

*Bothriurus bonariensis* (C.L.Koch, 1842): Paraguay 1♂1♂E;

Brazil, Ceará 1♂E.

*Bothriurus dorbignyi* Guérin, 1843: Argentina 1♀E.

*Bothriurus* sp.: Paraguay 1♂E leg. Šedý.

*Cercophonius squama* (Gervais, 1844): Tasmania 1♀A det. Simon 1902;

Australia 1♀E leg. Baum.

*Phoniocercus pictus* Pocock, 1893: Chile 1♀E.

*Thestylus glazioui* (Bertkau, 1836): Brazil, Sao Paulo 4♂2♂2juv.A

1♂1♂1juv.E 1920-1927 leg. Mráz; St. Catharina 1♂2juv.E leg. Mráz.

**Buthidae** Simon, 1879

*Ananteris pydanieli* Lourenco, 1982: Surinam 1♂E.

*Androctonus amoreuxi* (Audouin & Savigny, 1812): Algeria, Colomb. Béchar 1 juv. E leg. Zouat;

1♀A 1♂E no location.

*Androctonus australis* (Linné, 1758): Algeria, Ain Zatou, Mts Aurés 1♂1♂A 27.5.1977

leg. Horák, Hammam Salahine near Biskra 1 juv. A 28.5.1977 leg. Horák, Ed-dis 2 juv. E 1974,

3 juv. A b coll. Kovařík 1990; Tunisia, Bizerta 1♀E leg. Salvator, Gafsa 2♂3♂A.

6.7.1964; Libya, Tripoli 1♂E 8.1978 leg. Horká; 1♀E no location.

*Androctonus bicolor* (Hemprich & Ehrenberg, 1829): Tunisia, 1♀E 8.1978 leg. Horká; 1♀E no location.

*Androctonus crassicauda* (Olivier, 1807): Iraq, Bagdad 16♂5♂10 juv. A 7♂4♂6 juv. E 1929

leg. Kálalová; Iran, Kurdistan Shaklava 1♀A leg. Kálalová, 1♂E 1977 Exp. Nat. Mus. Prague;

Palestine, Belh Alfa 1♀E leg. Milič; Persia 1♀E leg. Kargl; Greece, 1♀A 1♂E leg. Salvator, 1♂1♂E

no location.

*Androctonus mauretanicus* (Pocock, 1902): Morocco 1♂E.

*Babycurus neglectus* Kraepelin, 1897: Gabon 1♀E.

*Buthotus alticola* (Pocock, 1895): China, Kwangsi 1♀E.

- Buthotus franzwernerii gentili* (Pallary, 1924): Morocco, 3q3d5 juv. E.
- Buthotus hottentota* (Fabricius, 1793): lqE no location; 2qA coll. V. Frič 1900.
- Buthotus minax* (C. L. Koch, 1875): Sudan, Wad Medani 2qlđE 8.8.1982 leg. Kotásek.
- Buthotus pachyurus* (Pocock, 1897): India, Sangli 1 juv. E.
- Buthotus rugicustis* (Pocock, 1897): India, Mysore state Shimoga lđE.
- Buthotus saulcyi* (Simon, 1880): Iraq, Bagdad lđE leg. Kálalová; Iran, lqE exp. Nat. Mus. Prague 1977.
- Buthotus tamulus* (Fabricius, 1798): India, mouth of a river Ganges 3qlđA 1qE leg. Šmala.
- Buthus occitanus* (Amoreuxi, 1789): Morocco, lqlđ2 juv. E; Algeria, Tebesa lqlđA 12.6.1930 leg. Obenberger, Djebel Aures lqlđ4 juv. A leg. Táborský, Rivet near Algiers lqlđA 16.5.1971 leg. Horák, Djebel Djudjura lđ1 juv. A 13.6.1971 leg. Horák, Ed-dis 3qlđ1 juv. E 1974, 2qlđE; Tunisia, lqlđE coll. Salvator, Cairo 3ql juv. A 1930 leg. Táborský, El-Kep lq2d3 juv. A leg. Táborský, Air Draham lq4 juv. A 6.1937 leg. Mařan; Spain, Murcia 7 juv. A leg. Baum, Arenas 3 juv. A lqđE leg. Baum, Benidorm lđ1 juv. 7.1989 leg. Sova; Iraq, Bagdad lđE leg. Kálalová; lqlđE no location.
- Centruroides bicolor* (Pocock, 1898): Panama, Chiriquí lqlđE.
- Centruroides exilicauda* (Wood, 1863): Mexico, Quaaymas 1 juv. A lđE 28.12.1927, Topobobampo lq2 juv. A 23.12.1927, Inocentes 2qA 29.1.1928, La Paz 2qA 1qE 30.1.1928.
- Centruroides gracilis* (Latreille, 1804): Cuba, lđ1 juv. E leg. Houba, 1 juv. E, lqA 1988. 1o1oA lqlđE coll. Kovařík 1990; lqE no location.
- Centruroides infamatus* (C. L. Koch, 1821): Mexico, lqE.
- Centruroides subgranosus* (Kraepelin, 1898): lqA no location.
- Compsobuthus mathiesseni* (Birula, 1905): Iraq, Bagdad 84q34d3 juv. A 3q2d1 juv. E leg. Kálalová.
- Grosphus madagascariensis* (Gervais, 1844): Madagascar, Antalaba lđE, 6qE 1902.
- Isometrus maculatus* (Geer, 1758): Madagascar, lqA 1900; Peru, Juanjui lqlđE, Callanga lq3dE; lqA no location.
- Leiurus quinquestriatus* (Hemprich & Ehrenberg, 1829): Tunisia, Cairo 7q5d25 juv. E leg. Salvator; Sudan, lqE leg. Machulka, Chartum lqE 1904, Wad Medani lqE 8.8.1982 leg. Kotásek.
- Lychas burdoi* (Simon, 1882): Tanzania, lqlđE.
- Lychas* sp.: Indonesia, Island Bali lE.
- Mesobuthus eupeus* (C. L. Koch, 1813): Iraq, Bagdad 44ql7d88 juv. A 7q4d10 juv. E leg. Kálalová; USSR, Caucasus Tiflis lqlđE, Armenia Erevan lqA 1959 leg. Staněk; Iran, Ab-barum Demavend 2q4 juv. A 23.7.1970, 1 juv. A 1970 exp. Nat. Mus. Prague, Isin lđE 11.4.1973 exp. Nat. Mus. Prague, Kandavan lđA 9.7.1977; Corea, Seoul lqE; Persia lqA lđE; 6q3d1 juv. E no location.
- Mesobuthus gibbosus* (Brullé, 1822): Bulgaria, lđA; Jugoslavia, Monte Negro 3qlđ7 juv. E 6.1965 leg. Voděra; Greece, Parnas Dahvi 2d1 juv. A 31.5.1935, Gaudos 27q9d43 juv. A 7q2d3 juv. E 12.-20.5.1938 leg. Táborský, Hypati 1 juv. E 5.1936 leg. Táborský, lq2dA lqlđE leg. Salvator, Crete Askyphe lq6 juv. A 12.5.1938 leg. Táborský, Crete Ida lq4 juv. A 1938 leg. Táborský; Turkey, Ankara Barai 1 juv. A 4.7.1947; Cyprus, lqE; Syria, Zagrín near Latakia lql juv. A 24.2.1982 leg. Pfleger.
- Mesobuthus martensi* (Karsch, 1879): China, Singley lđE.

- Odonturus dentatus* Karsch, 1879: Tanzania 1♂1 juv. E.
- Olivierus caucasicus* (Nordmann, 1840): USSR, Buchara 1♂E, Margilan 1♂E, Fergana Kokand 1♂E; Afganistan, Kabul 1♂A 9.1963; Persia 2♀1 juv. E; 2♂1♂E no location.
- Orthochirus innesi* Simon, 1910: Syria, Palmyra 1♂A 26.4.1982 leg. Pfleger; Iraq, Bagdad 1♂E leg. Kálalová.
- Orthochirus scrobiculosus* (Grube, 1873): USSR, Caucasus Tiflis 1♂E, Krasnovodsk 1♂A leg. V. Frič, Turkmenia Bayran Ali 1♂A leg. Pfleger, Uzbekistan Chrebet Nuratau 1 juv. A 5.1989 leg. D. Král; Iran, W. Sabzwarán 1♂E 7.5.1973 exp. Nat. Mus. Prague.
- Parabuthus capensis* (Hemprich & Ehrenberg, 1828): Republic of South Africa, 2♂A leg. Holub.
- Rhopalurus junceus* (Herbst, 1800): Cuba, 1♂2 juv. E, 1♂A b coll. Kovařík 1990.
- Tityus androcottoides* (Karsch, 1879): Venezuela, 1♂1♂A 1♂1♂E 1891 leg. Vráz.
- Tityus bahiensis* (Perty, 1830): Cameroon, Douala 1♂E 1929 leg. David; Brazil, Bahia 1♂E, São Paulo 1 juv. A 1♂E 1925 leg. Mráz.
- Tityus dasyurus* Pocock, 1897: 1♂E no location.
- Tityus forcipula* (Gervais, 1844): Colombie, Tolima 1♂E 1908.
- Tityus kraepelinianus* Mello-Leitao, 1931: Venezuela, 3♂1♂E.
- Tityus trivittatus* Kraepelin, 1898: Brazil, Espírito Santo 1♂E; 5♂E no location.
- Uroplectes formosus* Pocock, 1890: Republic of South Africa, 1♂E.
- Uroplectes triangulifer* (Thorell, 1877): Republic of South Africa, 1E.
- Chactidae Laurie, 1896
- Chactas amazonicus* Simon, 1880: Peru, Juanjui 1♂E.
- Chactas* sp.: Colombie 1♂E.
- Chactinae gen. sp.: Mexico, La Paz 1♂1 juv. E 1928.
- Euscorpius (Euscorpius) carpathicus* (Linnaeus, 1767):
- Bohemia the mapping square no. 6252, 2♂A 30.8.1959 leg. Gotlieb, 8♂1 juv. A 5.6.1960 leg. Táborský, 2♂E 27.4.1960 leg. Voděra, 3♂A 31.3.1961 leg. Táborský, 6♂A 1962 leg. Táborský, 4♂1♂E 16.5.1962 leg. Voděra, 2 juv. E 10.5.1963 leg. Voděra, 2♂E 7.6.1964 leg. Voděra, 4♂8 juv. A 24.4.1969 leg. Pfleger, 2♂A 6.5.1971 leg. Pfleger; Italy, Lago di Garda 1♂A 6.8.1893 leg. Vávra, Alps 1♂E, Calabria Capo Spulica 5♂1 juv. A 18.4.1990 leg. Kůrka, Lago Dilesin 1♂1 juv. A 15.4.1990 leg. Kůrka; Jugoslavia, Zagreb 3 juv. A leg. Růž. Hercegovina Nevesinje 2♂A, Plitvice 1♂A, Bosnia 1♂2♂E 1♂3♂1 juv. A, Monte Negro 4♂E 1902 leg. Mrázek, Sarajevo 3♂E 1908 leg. Höhm, near lake Ljubol 1 juv. A 28.6.1930 leg. Štorkán, Breznica 6♂4♂A, Makarska 1♂E 7.1933, Hvar 2 juv. A 21.7.1977 leg. Tauber; Rumunian, 130♂23♂3 juv. A; Bulgaria, 1♂A leg. Petrič, Sandanski Pirin 1♂A 1970 leg. Horák, Albania, 1♂1♂E 1917; Greece, Creta Ida 5♂1 juv. A 1♂E, Parnas 2♂4♂7 juv. A 2.6.1935 leg. Táborský, Thessalia 1♂E 21.6.1935 leg. Mařan, Olympus 2♂2 juv. A leg. Táborský, Taygetos 1 juv. A 1♂E 1935 leg. Mařan, Kataphigion 1♂1♂A 20.6.1974 leg. Horák.
- Euscorpius (Euscorpius) germanus* (C.L. Koch, 1836): Jugoslavia, Bosnia 1 juv. A 18.9.1929; Austria, Tyrol Ampezzothal 1♂E; 46♂6♂1 juv. A 1♂E coll. V. Frič.
- Euscorpius (Euscorpius) mingrelicus* (Kessler, 1876): USSR, Sochi 1♂E 21.6.1990 leg. Kovařík.
- Euscorpius (Polytrichobothrius) italicus* Herbst, 1800: Italy, Lago di Garda 1♂1 juv. A 1♂E 1893 leg. Vávra; Jugoslavia, Bled 1 juv. A, Bosnia Ragacia 3♂1♂A, Brach 1♂A 10.8.1971 leg. Sulim.

- Albania 2♀E 1917; Turkey 1♂E; USSR, Batumi 1♂E 16.6.1957 leg. Mařan; 20♀7♂3juv. A no location; 4♀E are specified in the collection: "New Zealand leg. Erban". Probably the labels of the localities have been changed or the specimens have been brought.
- Euscorpius (Tetratrichobothrius) flavicaudis* Birula, 1917: France, Ville 1♀1♂3juv. A; Italy, Campagna 2♀4juv. A 1901 leg. Dršvič, Rome 2♀A 1930 leg. Táborský, Nizza 2♀A 1898 leg. Frič, Sardinia 2♀E, Corsica 1♀E; Algeria 1♀E; 1♀1♂E no location.
- Megacormus gertschi* Diaz, 1966: Mexico, Hidalgo Zacualtipan 1♀1♂E 8.7.1992 leg. V. Malý.
- Chaerilidae Kraepelin 1894
- Chaerilus variegatus* Simon, 1877: Java, Mons Gede 1♀E 8.1892 leg. Fruhstorfer.
- Diplocentridae Kraepelin 1905
- Bioculus* sp.: Mexico, La Paz 1♀1♂1juv. E. 1928.
- Nebo hierichonticus* (Simon, 1872): Yemen, 3juv. A b 1989 leg. Nečas.
- Ischnuridae Simon, 1879
- Cheloctonus crassimanus* Pocock, 1896: Republic of South Africa, 1♀1♂E 1938 leg. Baum.
- Iomachus politus* Pocock, 1896: Tanzania, 2♀1♂E.
- Liocheles australasiae* (Fabricius, 1775): 1♀E no location.
- Liocheles caudicula* (C.L. Koch, 1844): New Guinea, 1♀1♂E leg. Vráz.
- Opisthacanthus elatus* (Gervais, 1844): 1♀1♂1juv. A coll. Berchthold et Kraepelin.
- Opisthacanthus fischeri* Kraepelin, 1910: Tanzania, 1♀E.
- Opisthacanthus validus* Thorell, 1877: Republic of South Africa, 1♂E leg. Nonfried.
- Opisthacanthus* sp.: 2♀2♂E no location.
- Iuridae Pocock, 1893
- Hadrurus hirsutus* (Wood, 1863): Mexico, La Paz 1♂E 1928.
- Iurus dufourei* (Brullé, 1832): Greece, Mistras 1juv. A 7.1990 leg. Šklíba.
- Scorpionidae Pocock, 1893
- Heterometrus (Chersonometrus) phipsoni* (Pocock, 1892): 1♀A no location.
- Heterometrus (Gigantometrus) swammerdami* Simon, 1872: Ceylon (Sri Lanka), 2♀1♂E leg. Nonfried.
- Heterometrus (Heterometrus) spinifer* (Hemprich and Ehrenberg, 1828): Cambodia, Takeo 1♀E 1984 leg. Frühbauer.
- Heterometrus (Heterometrus) longimanus* (Herbst, 1800): Borneo, 4♀1♂1juv. A 2juv. E leg. Vráz; Sumatra, 3♂A leg. Hildebrandt.
- Heterometrus (Javanimetrus) cyaneus* (C.L. Koch, 1836): Java, 1♀1♂A coll. V. Frič, 1♀A 1906 leg. Urbánková, Vulcan 2♀E leg. Gürda.
- Heterometrus (Srilankometrus) indus* (Geer, 1778): Ceylon, Peradeniya 2♂E leg. Uzel.
- Opisthophthalmus capensis* (Herbst, 1800): Republic of South Africa, Tatelberg 1♂E 1897 leg. Höhm, 1♀E leg. Holub.
- Opisthophthalmus glabrifrons* Peters, 1861: Tanzania, 1♀E.
- Opisthophthalmus pallidipes* C.L. Koch, 1843: 1♀E no location.
- Opisthophthalmus pictus* Kraepelin, 1894: Republic of South Africa, 1A leg. Holub.
- Opisthophthalmus pugnax* Thorell, 1877: Republic of South Africa, 1A leg. Holub.
- Opisthophthalmus schultzei* Kraepelin, 1908: Zambia, Zambezi 1♀E leg. Holub.





*Opisthophthalmus* sp. : Gabon, ♀E.  
*Pandinus (Pandinoides) cavimanus* (Pocock, 1888): Kenya, Ugamba 4♂♂ juv. A leg. Machuli-  
 ka; Tanzania 1♀♂E.  
*Pandinus (Pandinopsis) dictator* (Pocock, 1888): Cameroon, Douala 1♂A leg. David; 4♀♂A 1♂E  
 no location.  
*Pandinus (Pandinus) imperator* (C.L. Koch, 1842): 3♂A coll. V. Frič; ♀E no location.  
*Scorpio maurus* Linné, 1758: Morocco, 6♀♂ juv. E; Algeria, Akbou 1♀A 9.5.1971 leg. Halaš,  
 Ghardibaou 1♀A 5.5.1971 leg. Halaš, Tebessa 1♀♂A 12.6.1930 leg. Obenberger, Ed-dis 1♀E  
 1974; Tunisia, El-Kep 2♀♂A leg. Táborský, Ain-Draham 1♂A 6.1927 leg. Mařan, Cairo 1 juv. A  
 5.1930; Syria, Palmyra 1 juv. A 26.4.1982 leg. Pfeleger; Iraq, Bagdad 3♀E leg. Kálalová.  
*Urodacus novaehollandiae* Peters, 1861: Australia, Melbourne 1♀A 1902 Det. Kraepelin.  
*Vejovidae* Thorell, 1876  
*Paruroctonus* sp. : Mexico, La laguna 1♀A 9.2.1928.  
*Scorpiops hardwickii* (Gervais, 1844): India, Sikkim 1♂E, Hindustan 1♀E leg. Schlaginxeix.  
*Uroctonus* sp. : IE no location.  
*Vejovis mexicanus* C.L. Koch, 1836 : Mexico, IE

#### SUMMARY

The collection of scorpions in the Zoological Department of the National Museum in Prague includes 1360 specimens of 94 species, 44 genera and 9 families. According to Williams (1987), the world fauna of scorpions consists of 1500 species in 112 genera. The collection in the National Museum includes 6.26 % of species, 39.29% of genera, and all families of the Scorpiones (6 species of Bothriuridae, 44 species of Buthidae, 9 species of Chactidae, 1 species of Chaerilidae, 2 species of Diplocentridae, 8 species of Ischnuridae, 2 species of Iuridae, 18 species of Scorpionidae and 4 species of Vejovidae). The most interesting is material of *Euscorpion carpathicus* (Chactidae) from the mapping square No. 6252 (Central Bohemia) and the scorpions collected in Iraq (for the details see also Kovářík (1992)).

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### THREE SPECIES OF NEMATODES OF THE SUPERFAMILY DRACUNCULOIDEA FROM AUSTRALIAN FISHES

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**Abstract.** Examination of some freshwater and marine fishes, carried out in south-eastern Australia in 1990, revealed the presence of three adult dracunculoid nematodes representing two new, previously undescribed species, *Philometra kohnae* sp. n. and *Philometra lomi* sp. n., from the subcutaneous pouches and subcutaneous tissues, respectively, of the marine fish *Tylosurus gvalaloides*, and one species, *Anguillicola novaezelandiae* from the swimbladder of the freshwater eel *Anguilla australis*, that has not hitherto been reported from Australia. *P. kohnae* (females only) is characterized mainly by the shape and size of the body (length 34-76 mm), presence of eight large cephalic papillae and a conspicuously large anterior oesophageal bulb well separated from the rest of oesophagus. The female of *P. lomi* resembles that of *P. sydneyi* in body length (135 mm), but differs mainly in the structure of the cephalic end and in a slightly swollen anterior end of the oesophagus.

Examination of a few samples of adult nematodes collected from freshwater and marine fishes of south-eastern Australia (New South Wales and Victoria) in 1990 revealed the presence of three species of dracunculoid nematodes; two of them represent new species, while the third one has not previously been reported from Australia. This paper gives an account of these remarkable nematode parasites.

#### MATERIALS AND METHODS

The nematodes after dissection out of the host were fixed and stored in 4% formaldehyde. For examination they were cleared in glycerine. *En face* views were prepared according to Anderson's (1958) method. Drawings were made with the aid of a Zeiss microscope drawing attachment. The specimens have been deposited in the helminthological collection of the Queensland Museum in South Brisbane. Measurements are given in micrometres unless stated otherwise.

*Anguillicola novaezelandiae* Moravec et Taraschewski, 1988

(Fig. 1)

**Description:** Anguillicolidae, *Anguillicola*. Body fusiform, plump, darkly coloured. Epicuticle aspinose. Head end with slight neck constriction just anterior to nerve ring. Mouth aperture circular, surrounded by four cephalic papillae and two lateral amphids. Buccal capsule small, with 27 minute circumoral teeth in one female. Posterior part of oesophagus markedly expanded. Valvular apparatus of oesophagus well developed. Nerve ring located directly behind

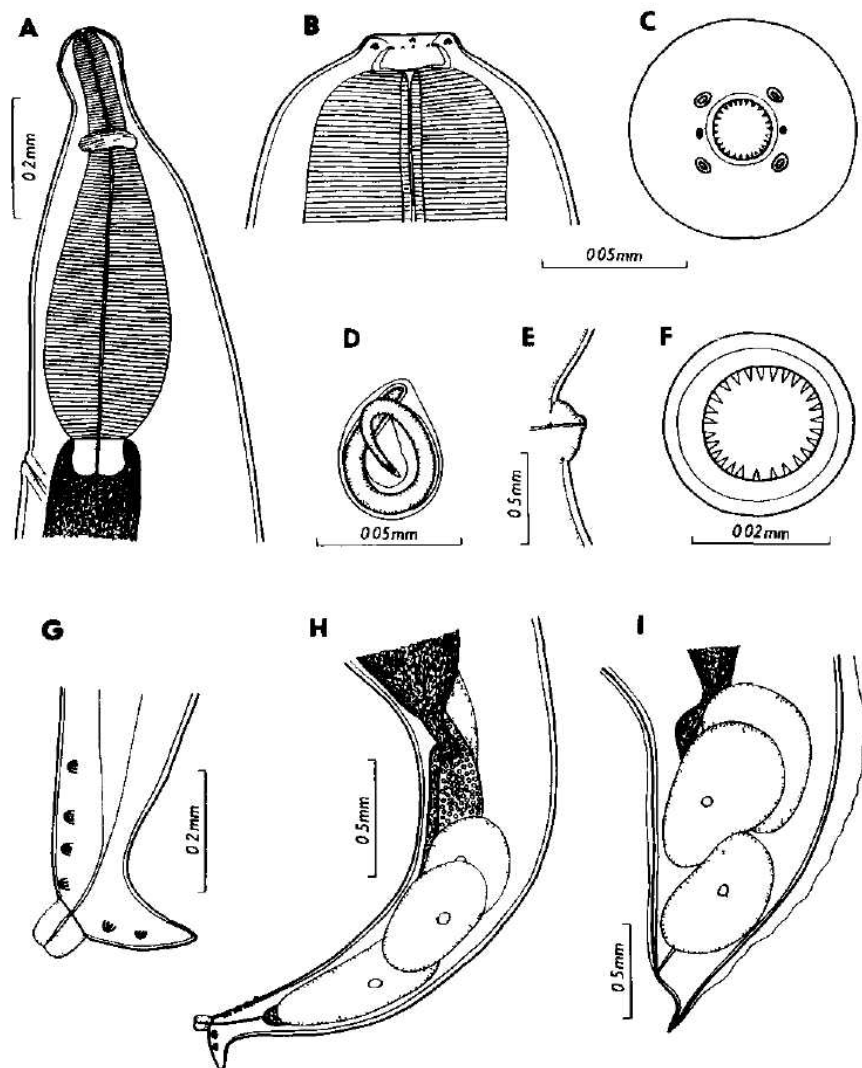


Fig 1 *Anguillicola novaezealandiae* Moravec et Taraschewski, 1988 A- anterior end of gravid female, B,C- head end of gravid female, lateral and apical views, D- ensheathed larva from uterus, E- vulva, F- buccal capsule of female, apical view, G- tail of male, H- posterior end of male, I- posterior end of female

neck constriction, excretory pore near junction of oesophagus and intestine. Intestine dark, almost straight, broad. Three conspicuously large oval unicellular rectal glands present; additional small rectal gland, overlapped by large ones, also present. Tail conical, pointed.

**Male** (3 specimens): Length of body 20.6-24.4 mm, maximum width 1.1-1.3 mm. Length of slightly enlarged head end 163, its width 122; width of body at neck constriction 109. Buccal capsule 12 long and 24-27 wide, maximum thickness of its wall 2. Length of oesophagus 830-884, its maximum width 218-231. Length ratio of oesophagus and body 1 : 23-29. Distance of nerve ring and excretory pore from posterior extremity 231-245 and 870-966, respectively. Common cloacal duct opening on prominent process 82-95 long. Size of large rectal glands 408-476 x 272-367, that of small one 150 x 95. Six pairs of caudal papillae present; 4 preanals and 2 postanals. Tail conical, 231 long.

**Female** (4 specimens): Length of body of gravid females with larvae 20.4-47.0 mm, maximum width 1.6-3.0 mm. Length of slightly enlarged head end 163-177, its width 122-150; width of body at neck constriction 109-136. Buccal capsule 9-12 long and 30 wide; maximum thickness of its wall 2. Length of oesophagus 925-1074, its maximum width 218-231. Length ratio of oesophagus and body 1 : 20-51. Distance of nerve ring and excretory pore from anterior extremity 258-340 and 1020-1050, respectively. Vulva elevated, prominent, situated in posterior part of body, 4.4-7.7 mm from posterior extremity, this representing approximately 1/4 - 1/6 of body length. Ovarian tubes not reaching anteriorly level of oesophagus. Uterus containing sheathed larvae 249-279 long and 15-18 wide. Size of large rectal glands 558-966 x 340-775, small rectal gland measuring 204 x 272 in largest specimen. Tail conical, 245-367 long, pointed.

**Host:** Short-finned eel, *Anguilla australis* Richardson (Anguillidae, Anguilliformes).

**Site:** Swimbladder.

**Locality:** Reedy Lake near Geelong, Victoria, Australia (October 1990).

**Comments:** The morphology of the present specimens corresponds, more or less, to the original description of *Anguillicola novaezelandiae* given by Moravec & Taraschewski (1988), but their body measurements are somewhat greater (Table 1). However, these differences can be considered to be within the range of intraspecific variability and there is no doubt that the Australian *Anguillicola* specimens from *Anguilla australis* belong to this species. van Banning & Haenen (1990) mention that another congeneric species, *Anguillicola crassus*, can infect eels soon after immigration of elvers into fresh water and the nematodes can mature and adapt their size to the restricted lumen of the small swimbladder.

The number of peribuccal teeth in one female of the present material was 27, whereas Paggi et al. (1982) found 32 teeth in specimens from Italy. Apparently the number of teeth is variable within the same *Anguillicola* species. Various authors (see Moravec & Taraschewski, 1988) reported 21-28 peribuccal teeth in *A. crassus*.

*Anguillicola novaezelandiae* is known from the short-finned eel (*Anguilla australis*) from New Zealand and from the European eel (*A. anguilla*) from Italy where it was probably introduced from New Zealand along with a stock of *Anguilla australis* introduced into Lake Bracciano near Rome in 1975 (Welcomme, 1981; Paggi et al., 1982; Moravec and Taraschewski, 1988). The present finding is the first record of *A. novaezelandiae* from Australia.

The only *Anguillicola* species previously reported from Australian eels was *A. australiensis*

Johnston et Mawson, 1940 from the long-finned eel (*Anguilla reinhardtii*) from Prospect Reservoir near Sydney, New South Wales; it has not been recorded in Australia since. *Anguillicola australiensis* and *A. novaezelandiae* differ distinctly from each other in their morphology and measurements (see Moravec & Taraschewski, 1988) and probably in their hosts as well; it is possible that *Anguillicola australiensis* occurs only in *Anguilla reinhardtii*, whereas *A. novaezelandiae* occurs in *A. australis*. Both eel species are distributed along the east and south-east coast of Australia and in Tasmania, and are well distinguished one from each other morphologically. According to Schmidt (1928), both species are Pacific forms of which *A. reinhardtii* is tropical, extending far into the temperate zone, while *Anguilla australis* clearly appears to be temperate. *A. australis* is native to both New Zealand and Australia.

Table 1. Comparison of body sizes of *Anguillicola novaezelandiae* and *A. australiensis*

Species	<i>Anguillicola novaezelandiae</i>			<i>A. australiensis</i>
Host	<i>Anguilla australis</i>	<i>A. australis</i>	<i>A. anguilla</i>	<i>A. reinhardtii</i>
Locality	Australia	New Zealand	Italy	Australia
Source	Present study	Moravec & Taraschewski (1988)	Paggi et al. (1982)	Johnston & Mawson (1940)
Length of male	21 - 24 <sup>a)</sup>	6-9	10-25	40
Maximum width of male	1.1-1.3	0.5-0.7	0.5-1.8	1.0
Length of gravid female	20-47	10-14	24-32	60-70
Maximum width of gravid female	1.6-3.0	0.7-1.2	2.2-3.1	1.5

<sup>a)</sup> Measurements in mm.

*Anguillicola australiensis* was also reported from *Anguilla australis* and *A. dieffenbachii* from New Zealand (Brunsdon, 1956; Rid 1973; Hewitt & Hine, 1972; Hine, 1978; Boustead, 1982; Blair, 1984). However, since no description or drawings of these parasites were provided, Moravec & Taraschewski (1988) have speculated that these reports might refer to *Anguillicola novaezelandiae*. However, since *Anguilla dieffenbachii* and *A. reinhardtii* are closely related species, the first restricted to New Zealand, the second one to Australia, it may well be that they are both parasitized by *Anguillicola australiensis*.

In order to exclude possible doubts regarding species identification, we considered it quite necessary to present a redescription of *Anguillicola novaezelandiae* based on Australian specimens, which also extends the present knowledge of the morphometrical variability of this parasite species.

**Description of female** (3 specimens; measurements of holotype in parentheses): *Philometridae, Philometra*. Body of gravid and subgravid females darkly coloured, cylindrical, somewhat tapering to both ends. Cuticle smooth. Length of body 33.5-75.8 (75.8) mm, maximum width 1.1-1.7 (1.7) mm. Head end blunt, wide, provided with marked cephalic papillae 18-27 (18) high. Oral opening circular, surrounded by four pairs of large outer cephalic papillae and a pair of small lateral amphids; inner papillae not observed. Mouth slightly depressed. Anterior end of oesophagus forming conspicuous, strongly muscular transverse bulb, well separated from cylindrical portion of oesophagus; bulb 177-204 (204) long and 258-340 (340) wide. Longer, posterior portion of oesophagus almost cylindrical, provided with well developed, wide oesophageal gland extending anteriorly up to nerve ring level; oesophageal gland containing large cell nucleus located somewhat behind its mid-length, at 820-1430 (1430) from anterior extremity. Posterior end of oesophagus protruding deeply into anterior end of intestine. Overall length of oesophagus including anterior bulb 1.4-2.4 (2.4) mm, representing 3-4 (3) % of body length; maximum width of cylindrical part (including oesophageal gland) 150-190 (190). Nerve ring encircling oesophagus 190-313 (313) from anterior end of body. Intestine dark, filled with erythrocytes, broad, becoming narrower only near posterior end; posterior end of intestine translucent ligament attached ventrally to body wall near posterior extremity. Posterior end of body rounded, without projections or papillae. Anterior ovary reaching anteriorly to nerve ring level, posterior ovary reaching to level of intestinal ligament. Uterus extending anteriorly to oesophagus region, containing numerous eggs; larvae not present.

**Type host:** Stout long tom, *Tylosurus gavioides* (Castelnau) (Belonidae, Atheriniformes).

**Site:** Encapsulated in subcutaneous pouches.

**Type locality:** Nambucca Heads near Coffs Harbour (30°30'S, 153°25' E), New South Wales, Australia (October 1990).

**Deposition of types:** Queensland Museum, South Brisbane, Qld, Australia (Cat. No. GL 18319 and GL 18320).

**Etymology:** This new nematode species has been named in honour of the outstanding Brazilian helminthologist Prof Anna Kohn, Instituto Oswaldo Cruz, Rio de Janeiro, who has contributed greatly to knowledge of fish helminths.

**Comments:** The family *Philometridae* includes a large number of species in freshwater and marine fishes. Males are unknown for many species and even genera and the classification is based principally on female morphology. In addition to morphological features, data on the site of localization of gravid females in the host's body are also important for the identification of *philometrids*.

Of many *Philometra* species, females of the following 9 species occur under the skin or in the fins of fishes: *Philometra bagri* (Khalil, 1965), *P. baueri* Vismanis et Nikulina, 1972, *P. beninensis* Obiekezic, 1986, *P. oreoleucisci* Moravec et Ergens, 1970, *P. pinnicola* Yamaguti, 1935, *P. plotosi* Moravec et Nagasawa, 1989, *P. rischta* Skrjabin, 1923, *P. Sebastodis* Yamaguti, 1941 and *P. Sydneyi* Rasheed, 1963. *P. kohnae* sp. n. differs from all these (as well as from the remaining *Philometra* species) in possessing a markedly large anterior oesophageal bulb, well separated from the remaining part of the oesophagus. In other species the oesophagus is swollen near the oral opening, but this inflation is not separated from the remaining part of the oesopha-

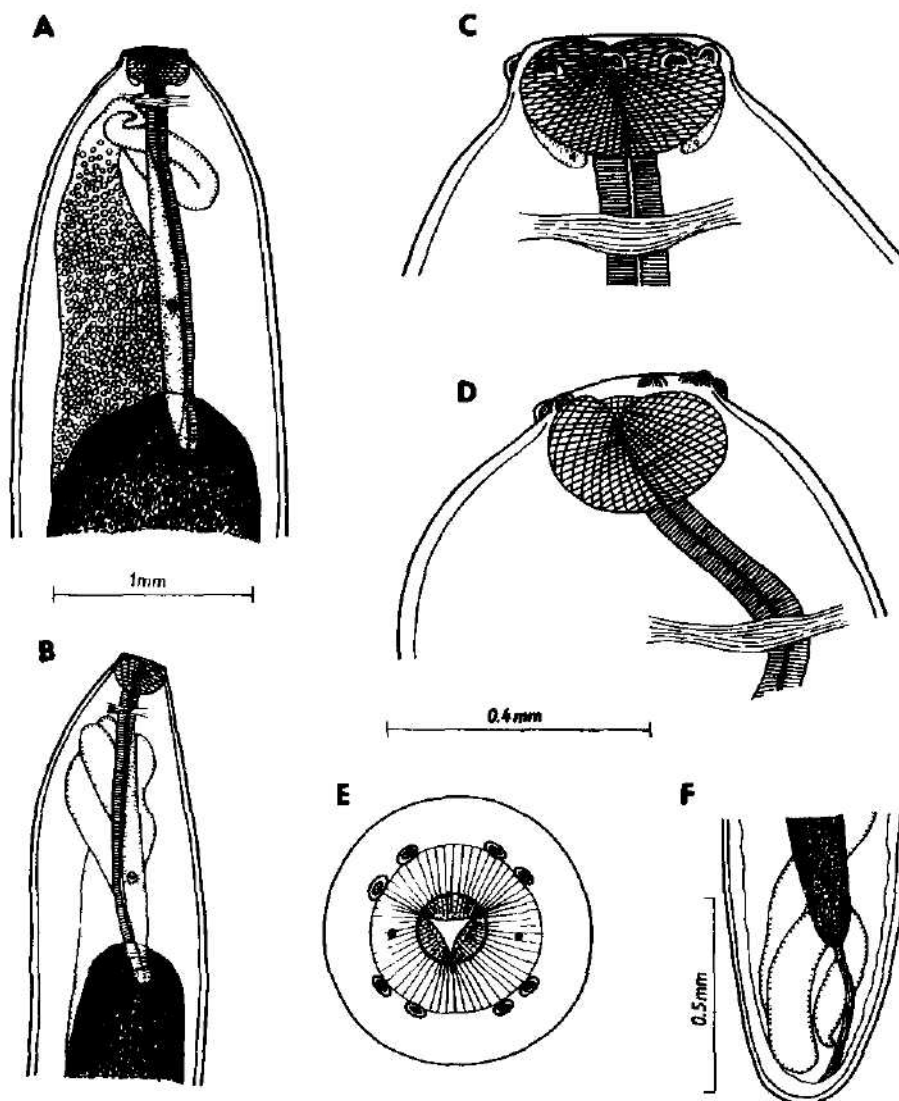


Fig. 2. *Philometra kohnae* sp. n. - female. A,B- anterior end of body, C,D,E- head end, lateral and apical views, F- posterior end of body, lateral view.

gus. Moreover, *P. bagri*, *P. baueri*, *P. oreoleucisci* and *P. rischta* differ from *P. kohnae* in possessing two large caudal processes and four conspicuous cephalic lobes that are absent in the new species.

The anterior end of the oesophagus of *P. pinnicola* is only slightly swollen, whereas the oesophagus of *P. Sebastodis* is much shorter than that of *P. kohnae* (0.24-0.27 mm vs. 1.36-2.38



mm); both these species were described from the fins of fishes in Japan. The body of *P. plotosi* is whitish and only 7-15 mm long (as compared to the dark-coloured body 33-75 mm long in *P. kohnae*). *P. sydneyi*, described from "a large white fish" from Australia, differs from the new species in the length of the oesophagus (about 5 mm vs. 1.4-2.4 mm), presence of three large oesophageal teeth, and the body reaching up to 150 mm. *P. beninensis*, a species described from the fins and the operculum of *Polydactylus quadrifiliis* (Polynemidae, Perciformes) in Africa, can be distinguished from *P. kohnae* mainly by the character (unseparated vs. separated) of the oesophageal bulb.

In comparison with other *Philometra* species, *P. kohnae* is very conspicuous by its darkly coloured gut, which is full of blood, resembling thus an *Anguillicola* species. Another interesting feature is that the nematode body is coiled to form a ball embedded inside a spherical capsule 5-8 mm in diameter; the capsule is apparently formed by connective tissue; it is whitish, thin-walled, provided with a small circular aperture by which the nematode can probably communicate with the surrounding tissues of the host body.

***Philometra lomi* sp.n.**

(Fig. 3)

**Description of gravid female (holotype):** Philometridae, *Philometra*. Body whitish, relatively long, tapering somewhat to round cephalic and caudal ends. Body 135 mm long, its maximum width 1.3 mm. Cuticle smooth. Head end rounded, with four distinct papilla-like lobes, each of them appearing to contain double cephalic papilla. Oesophagus somewhat swollen near mouth to form slight cephalic bulb; another, less obvious extension of oesophagus present immediately anterior to nerve ring. Overall length of oesophagus including cephalic bulb 3.3 mm, representing 2.5 % of whole body length. Dorsal oesophageal gland prominent, wide, extending anteriorly to short distance below nerve ring level. Posterior end of oesophagus with small ventriculus with relatively large oesophageal valve projecting into intestine. Oesophageal gland with large cell nucleus located somewhat anterior to its middle. Nerve ring 145 from anterior end of body. Intestine light-coloured, straight, displaced laterally by uterus; its posterior end atrophied. Posterior end of body somewhat narrowed, almost rounded, without any processes or papillae. Anterior ovary reaching anteriorly almost to nerve ring, posterior ovary almost to body end. Uterus occupying major part of body, filled with numerous larvae. Larvae slender, 450 long and 12 wide.

**Type host:** Stout long tom, *Tylosurus gavioides* (Castelnau) (Belontiidae, Atheriniformes).

**Site:** Subcutaneous tissue.

**Type locality:** Nambucca Heads near Coffs Harbour (30°30'S, 153° 25'E), New South Wales, Australia (October 1990).

**Deposition of type:** Queensland Museum, South Brisbane, Qld, Australia (Cat. No. GL 18318).

**Etymology:** The species is named in honour of Dr Jiří Lom, a well-known Czech fish protozoologist, who collected the present material.

**Comments:** Of the *Philometra* species parasitic beneath the skin or in the fins of their fish hosts, the present species resembles in its body size *P. sydneyi* Rasheed, 1963, a species described from the skin and the muscles of "a large white fish" from Sydney, Australia. All other species of this group are much smaller, their body length reaching 80 mm only in *P. kohnae*; they differ also in other features, for instance in the presence of large cephalic or caudal lobes, a

different size of the anterior oesophageal bulb, and a much shorter oesophagus. However, the new species lacks oesophageal teeth (whereas *P. sydneyi* possesses three large, pointed, strongly cuticularized oesophageal teeth protruding out of the oral opening). Furthermore, the anterior end of the oesophagus of the new species is only slightly swollen (whereas *P. sydneyi* has a broad oesophageal bulb), and the oesophageal gland is much broader.

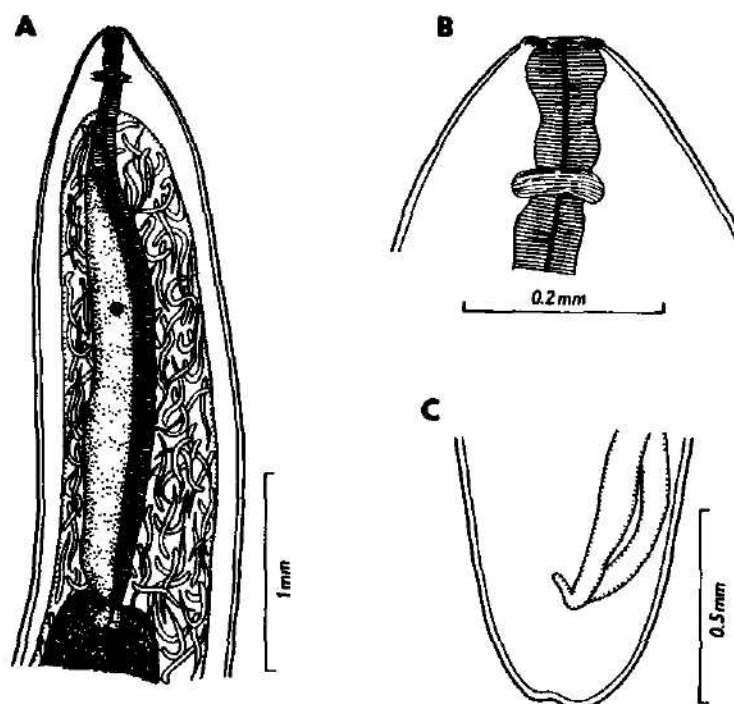


Fig. 3. *Philometra lomi* sp. n. - female. A- anterior end of body, B- head end, lateral view, C- posterior end of body, lateral view.

*P. lomi* sp. n. shows certain similarities with *P. pellucida* (Jägerskiöld, 1893) (syn. *P. sebastisci* Yamaguti, 1941), a species known to parasitize various species of marine fishes in Australia and Japan, including members of the family Belontiidae (see Ivashkin et al., 1971). However, in contrast to *P. lomi*, the oesophagus of this species is markedly shorter (1.3-1.6 mm vs. 3.3 mm), the body is dark-red in colour (vs. whitish), cephalic papillae are indistinct in lateral view, and there are two minute papillae on the caudal end that are absent in *P. lomi*. Also, both species occupy different sites in the host, the subcutaneous tissues in *P. lomi* and the testes in *P. pellucida*.

# Acknowledgements

Our thanks are due to Dr Jiri Lom of the Institute of Parasitology, Czechoslovak Academy of Sciences, who collected the nematode specimens used in this study during his short stay in the University of New England, Armidale, in 1990.

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## BOOK REVIEW

Coombs G. H. & North M. J. [editors]: *Biochemical Protozoology*. London, Washington DC: Taylor and Francis, 1991, 635 pp. Paper Price Lstg 20.00 / US Dollars 40.00

The last fifteen years have seen major advances in the understanding of the biochemistry of parasitic protozoa. However, until now there have been few attempts to cover this area comprehensively in a single volume. This publication is based on a 3-day symposium entitled "Biochemical Protozoology as a Basis for Drug Design", held at the University of Stirling, Scotland in 1990. It brings together recent work of 90 contributors and consists of 55 chapters. Each chapter is an individual read and gives a good number of references to the primary literature. Some chapters give an overview providing information on the current status of biochemical protozoology, on the biochemical activity and energy metabolism of malarial parasites, of *Giardia* cysts and trichomonads, of ciliated protozoa in the rumen ecosystem, of anaerobic protists, of leishmanias and African trypanosomes. 13 chapters are devoted to enzymes with show specificity towards proteins. The majority of proteinases in parasitic protozoa are known to hydrolyse proteins. Although the parasitic protozoa represent a very diverse group of organisms, the highest activity proteinases are often of the same type, the cysteine [thiol] proteinases. Discussed here are *Trypanosoma cruzi*, African trypanosomes, leishmanias, trichomonads, giardias and the dysentery amoeba, malarial plasmodia and *Babesia* species. Included are 15 chapters dealing with biochemistry of protozoan parasites and its relationships to chemotherapy. Potential targets for antiprotozoal drug development, drug-lipid interactions in the mechanism of action of antimalarials, drug resistance in malarial parasites, methionine recycling, trypanothione metabolism in trypanosomatids, purine and folate metabolism in protozoan parasites, the mode of action of benzimidazoles and mechanisms of resistance to nitroheterocyclic drugs, and possibilities for new antiprotozoal drugs are looked at. Some chapters deal with special aspects particularly suitable for investigation. For instance, the glycosome, a peculiar microbody-like organelle in representatives of the order Kinetoplastida, has been a subject of extensive studies during recent years. Other aspects include the mitochondria and mitochondrial metabolism of African trypanosomes and of the plasmodia, glycosylated phosphatidylinositols of the trypanosomatidae, leishmanial lipophosphoglycan, substrate transport systems and compartmentation in *Entamoeba histolytica*, nucleoside transport in malaria- and *Babesia*-infected cells, phosphomonoesterases in parasitic protozoa, genetic analysis of folate transport and metabolism in *Leishmania donovani*.

The book provides a valuable introductory source for biochemical protozoologists who will to expand their knowledge and for scientists who wish to become familiar with the biochemistry of parasitic protozoa.

J. Jir

## TWO LITTLE-KNOWN ACANTHOCEPHALANS FROM THE COMMON CORMORANT, *PHALACROCORAX CARBO*, IN CZECHOSLOVAKIA

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**A b s t r a c t.** During investigations into helminths of the common cormorant, *Phalacrocorax carbo* (L.), two acanthocephalan species of the family Polymorphidae, *Andracantha phalacrocoracis* (Yamaguti, 1939) and *Southwellina hispida* (Van Cleave, 1925) were found. The morphology of both acanthocephalans is briefly described, including scanning electron microscopy of their surface structures. The arrangement of spines on the *A. phalacrocoracis* trunk is rather variable with bare zone of different appearance and size in individual specimens. In *S. hispida*, a great variability in the number of hooks in longitudinal rows on the proboscis was revealed (14-19 hooks) whilst the number of longitudinal rows was relatively stable (20 rows in most specimens). *A. phalacrocoracis* has been found in Europe for the first time. The present finding of *S. hispida* represents the first record of this species from cormorants.

### INTRODUCTION

An examination of common cormorants, *Phalacrocorax carbo* (L.), from South Moravia, Czechoslovakia, carried out in 1992, revealed the presence of several species of helminth parasites, including two acanthocephalan species, *Andracantha phalacrocoracis* (Yamaguti, 1939) and *Southwellina hispida* (Van Cleave, 1925). Since both these parasites are inadequately known, the descriptions of their morphology are the subject of this paper.

### MATERIALS AND METHODS

The acanthocephalans were found in the small intestine of two out of 101 cormorants, *Phalacrocorax carbo* (L.)<sup>1)</sup> (Pelecaniformes: Phalacrocoracidae) with the intensity of infection as follows: 7 specimens of *A. phalacrocoracis* and 42 specimens of *S. hispida*. The worms were fixed under pressure with 4 % formaldehyde; after staining with Schuberg's carmine, they were dehydrated in an alcohol series and mounted in Canada balsam. Drawings were made with the aid of a Carl Zeiss drawing attachment. Measurements are given in mm unless otherwise stated. Specimens used for scanning electron microscopy (SEM) were fixed with hot 4 % formaldehyde, washed, dehydrated in graded alcohol and acetone, dried in CO<sub>2</sub> by the critical point method, gold-coated and examined in a Tesla BS 300 electron microscope.

<sup>1)</sup> According to Hudec & Černý (1972), the only subspecies of *Phalacrocorax carbo* (L.) occurring in Czechoslovakia, is *P. c. sinensis* (Shaw et Nodder, 1801)

# RESULTS AND DISCUSSION

*Andracantha phalacrocoracis* (Yamaguti, 1939)

(Fig. 1; Plates I,II<sup>2)</sup>)

Syn.: *Corynosoma phalacrocoracis* Yamaguti, 1939

**Description:** Trunk swollen in anterior portion, posterior portion slender (Plate I - Figs. 1, 2). Proboscis cylindrical, with swollen area, armed with 18 longitudinal rows of hooks of 10 to 12 each (Plate II - Figs. 1,4,6). Anterior 6-7 hooks with well-developed roots, next 4 (exceptionally 5 hooks present) rootless. First five to six hooks slender, sharply pointed, slightly larger and more stout from anterior end; hook VI (VII) much more robust than others (Plate II - Fig. 7). Posterior hooks (VII-XII) curved, spiniform, decreasing in size posteriorly. Size of hooks as follows (in  $\mu\text{m}$ ; length and maximum width of blade, length of root): I - 50-54 x 12-13, 26-31; II - 52-58 x 12-14, 43-45; III - 54-59 x 14-15, 43-49; IV - 55-61 x 15-18, 45-52; V - 59-67 x 19-23, 50-61; VI - 77-86 x 27-34, 79-86; VII - 54-61 x 17-18, 0 (rootless); VIII - 53-58 x 13-14; IX - 53-55 x 13-14; X - 46-54 x 10-12; XI - 40-52 x 8-10. Neck conspicuous. Trunk armed with 0.027 to 0.039 long spines. Spines arranged either in one wide field with small, narrow bare zone (Plate I - Figs. 1, 3, 5) or in two narrower fields separated each from another only by narrow bare zone (Plate I - Figs. 2, 4, 6). Anterior field composed of about 8 rows of hooks, posterior formed by 12-15 rows. Posterior part of trunk armed with several rows of small hooks, similar in shape and size (length 0.028-0.035) to those on anterior part of trunk (Plate II - Fig. 8); there is no connection between these spines and those of anterior part of trunk (Plate I - Fig. 2). Genital spines not observed.

**Male** (2 specimens, Fig. 1 B): Body 4.41 to 4.95 long, 1.75 to 1.85 greatest width. Proboscis 0.65 long, 0.104 wide in anterior end, 0.200-0.208 near base and 0.288-0.304 greatest width. Neck 0.41 long, 0.61 wide at base. Proboscis receptacle 1.02-1.32 long with maximum width 0.24-0.35. Lemnisci measuring 1.38-1.62 x 0.31-0.33. Testes doubled, ovoid, measuring 0.44 x 0.48 x 0.26-0.38. Cement glands hardly countable, 8 (?) in number, slender. Bursa 0.64-0.76 long and 0.32-0.53 wide.

**Female** (3 spec., Figs. 1 A, C, D): Body 4.59 to 6.60 long, 1.91 to 2.31 greatest width. Proboscis 0.63 long, 0.104-0.112 wide in anterior end, 0.240 near base and 0.320-0.344 greatest width. Trunk 3.96-5.28 long, armed as in male. Neck 0.63 long, 0.79 wide at base. Proboscis receptacle 1.22-1.46 long with maximum width 0.39. Lemnisci 1.23-1.54 long and 0.31-0.35 wide. Eggs 0.077 to 0.084 long and 0.031 to 0.041 wide.

**Host:** *Phalacrocorax carbo sinensis* (Shaw et Nodder, 1801).

**Site:** posterior part of small intestine and large intestine.

**Locality:** water reservoir Nové Mlýny near the village of Dolní Věstonice, South Moravia (Czechoslovakia), 8 April 1992.

**Remarks:** In most morphological characteristics, the specimens under study correspond with those described as *Corynosoma phalacrocoracis* by Yamaguti (1939) from the intestine of *Phalacrocorax pelagicus* in Japan. Under this name, the species was also listed by Petrochenko (1958) in his monograph.

However, Schmidt (1975) established a new genus *Andracantha*, comprising species with two fields of spines on the anterior, swollen trunk, and with genital spines in at least one sex

<sup>2)</sup>Plates I-IV will be found at the end of this issue.

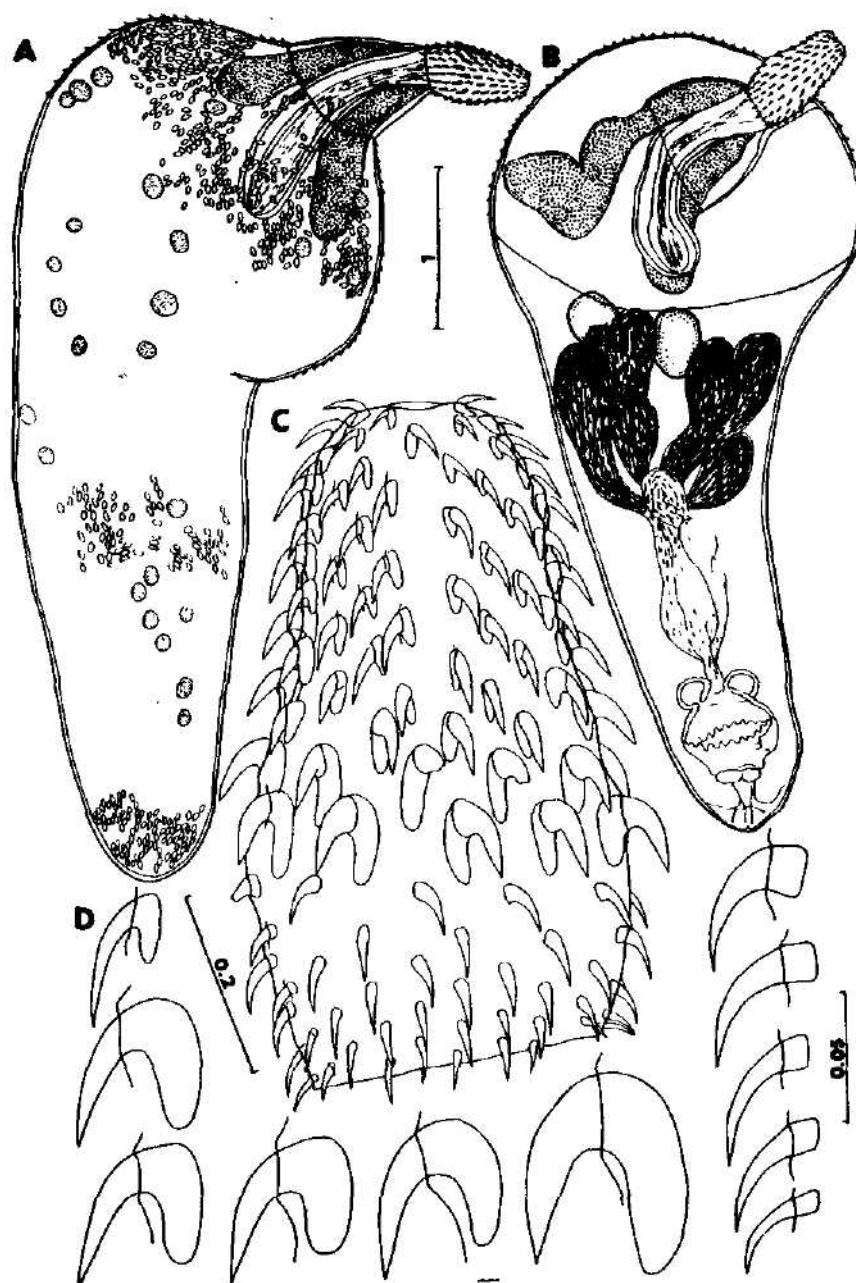


Fig. 1. *Andracantha phalacrocoracis* (Yamaguti, 1939). A - female, total view; B - male, total view; C - proboscis; D - hooks of proboscis. Scale bars in millimetres.

(spines covering the trunk are omitted, their distribution is documented in scanning electron micrographs, see Plate 1 - Fig. 2, and Plate 2 - Fig.8).



Nevertheless, the author admitted the absence of genital spines in some specimens studied by him, which casts doubts about the reliability of this morphological feature for generic diagnosis. Schmidt (1975) also placed in this genus the species *C. phalacrocoracis* and re-described it on the basis of re-examination of syntypes and original material from Alaska.

Amin (1985) listed *A. phalacrocoracis* as valid name in his survey of acanthocephalans. We also accept Schmidt's opinion and designate specimens from cormorants in South Moravia as *A. phalacrocoracis* because they are nearly identical with those described and figured by Schmidt (1975). There are only slight differences in the number of hooks in longitudinal rows (10-12 in specimens from Czechoslovakia while 10-14 in material of Schmidt) and in the arrangement of trunk spines: whereas Schmidt (1975) mentioned the presence of two distinctly separated fields of spines, the trunk of most specimens under study is covered with spines arranged in only one large field with small bare zone. Two distinct fields of spines were observed only in one female. The present data, therefore, indicate that the spination of the trunk is rather variable in individual specimens of *A. phalacrocoracis*. This fact should be mentioned because the spination of the body surface serves as an important taxonomic characteristics used in the identification of individual species or even genera of polymorphid genera (see Schmidt 1975).

The species *A. phalacrocoracis* has hitherto been found only in Shikoku Islands, Japan (type locality) and St. Lawrence Island and Nunivak Island in Alaska, USA, and as its definitive host only *Phalacrocorax pelagicus* has been reported (Schmidt, 1975). Consequently, the present finding represents the first record from Europe and *P. carbo* is a new definitive host.

*Southwellina hispida* (Van Cleave, 1925)

(Fig. 2, Plate III)

Syn.: *Arhythmorhynchus hispidus* Van Cleave, 1925; *A. fuscus* Harada 1929; *A. duocinctus* Chandler, 1935;

*Polymorphus ardeae* Belopolskaia, 1958; *Hemiechinomoma ponicum* Petrochenko et Smogorjevskaia, 1962.

**Description:** Trunk swollen in anterior portion, posterior portion slender (Plate III - Fig. 1). Anterior trunk with 2 fields of spines (Plate III - Figs. 2, 4). Proboscis cylindrical, with swollen area armed with 20 (in one male 19, in one female 18) longitudinal rows of 14-19 (mostly 15-17) each (Plate III - Figs. 2, 3). Anterior 7-8 hooks slender, abruptly curved (Plate III - Fig. 6); hooks in middle part (VIII-XI) stout, massive, with large roots (Plate III - Fig. 7); posterior 7-8 hooks rootless. Size of hooks as follows (in  $\mu\text{m}$ ; length and maximum width of blade, length of root): I - 52-55 x 13-15, 37; II - 57-58 x 15-17, 40; III - 63-66 x 17-18, 44; IV - 65-66 x 18-19, 52-53; V - 59-63 x 19-21, 53-54; VI - 55-62 x 17-21, 50-57; VII - 55-63 x 19-22, 52-58; VIII - 55-62 x 21-22, 54-71; IX - 52-62 x 22, 57-68; X - 40-49 x 14-18, 43-53; XI - 54-61 x 14-15, 0 (rootless); XII - 57-62 x 14-17; XIII - 62-66 x 14-15; XIV - 61-66 x 14-15; XV - 62-66 x 15-17; XVI - 62-65 x 14-15; XVII - 55-59 x 14-15. Neck conspicuous. Proboscis receptacle double-walled.

Male (7 specimens, Fig. 2 A): 5.16-8.55 long, 1.42-2.11 greatest width. Proboscis 0.83-0.89 long, its width in anterior end 0.096-0.104, near base 0.22-0.26, maximum width 0.32-0.36. Trunk 4.61-8.00 long, armed with 0.017 to 0.031 long spines in two fields separated by narrow bare zone. Anterior field 0.24-0.32 wide, composed of 5-7 transverse rows of hooks, posterior field 0.37-0.72 wide, consisting of 9-12 spines. Neck when everted 0.49 long and 0.57 wide at base. Proboscis receptacle 1.06-1.77 long with maximum width 0.39-0.47; lemnisci measuring

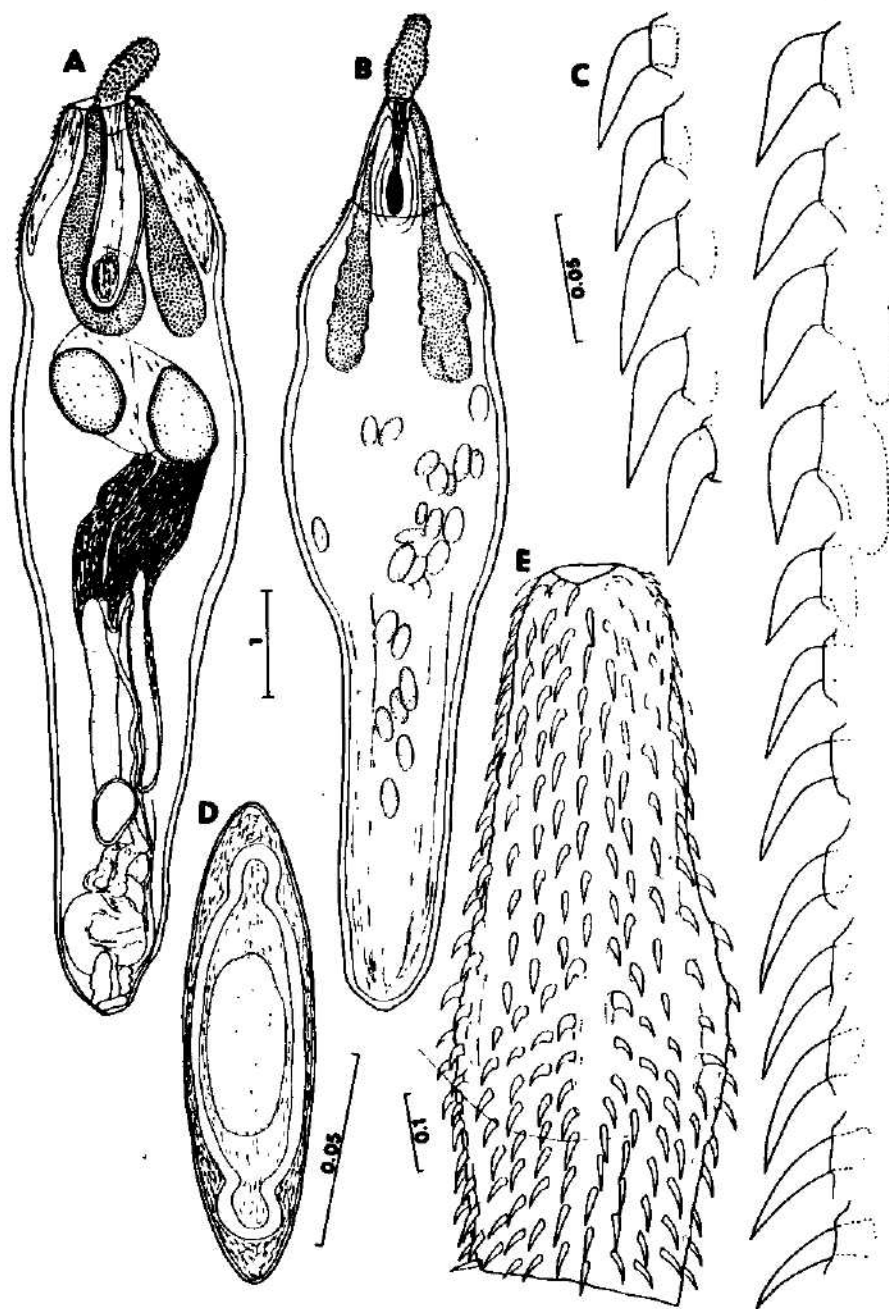


Fig. 2. *Southwellina hispida* (Van Cleave, 1925). A - male, total view; B - female, total view; C - hooks of proboscis; D - egg; E - proboscis. Scale bars in millimetres.

0.89-1.77 x 0.24-0.43. Testes ovoid; their size 0.52-0.85 x 0.46-0.67 (anterior) and 0.72-1.06 x 0.46-0.61 (posterior). Cement glands 4, slender, starting behind posterior testis, 1.30-2.84 long. Genital bursa 0.36-1.28 x 0.28-0.75 in size.

Female (7 specimens, Figs. 2 B-E): 7.65-11.00 long, 1.42-2.60 greatest width. Proboscis 0.85-0.93 long, 0.096-0.104 in anterior end, 0.32-0.38 in middle (maximum) and 0.22-0.28 in base. Trunk measuring 6.98-10.15 x 1.93-2.60, armed with 0.017 to 0.032 long spines in two fields separated by narrow bare zone. Anterior field 0.24-0.34 wide, composed of 6-8 rows of hooks, posterior one 0.40-0.80 wide, with 10-13 rows of spines. Neck measuring 0.77-1.02 x 0.61-0.91. Proboscis receptacle 1.24-1.50 x 0.43-0.51 in size. Lemnisci measuring 1.02-2.27 x 0.37-0.71. Eggs 94-108 long and 26-28 wide.

Host: *Phalacrocorax carbo sinensis* (Shaw et Nodder, 1801).

Site: posterior part of small intestine.

Locality: water reservoir Nové Mlýny near the village of Dolní Věstonice, South Moravia (Czechoslovakia), 8 April 1992.

Remarks: the specimens under study fit by their morphology into the diagnosis of *Southwellina hispida* as given in a paper by Schmidt (1973). There is only one difference in a number of hooks in longitudinal rows on the proboscis: whilst in the present study up to 19 hooks in a row was found, the authors quoted in Table 1 of the paper by Schmidt (1973) reported 12-17 hooks in *S. hispida*. However, this difference seems to represent an intraspecific variability within the populations of *S. hispida* from different hosts and geographical regions (see Schmidt, 1973). Moreover, the number of hooks fluctuated in the present material from 14 to 19 with highest frequency 15-17, which fits into the species diagnosis of *S. hispida*.

The species *S. hispida* was originally described by Van Cleave (1925) under the name *Arhythmorhynchus hispidus* on the basis of juvenile specimens from frogs in Japan. Wittenberg (1932) proposed *Southwellina* as a new genus, designating *A. hispidus* Van Cleave, 1925, as its type species. While following authors, studying the taxonomy of polymorphid acanthocephalans (e.g. Golvan, 1956; Petrochenko, 1958; Petrochenko & Smogorjevskaia, 1962; Yamaguti, 1963; Schmidt & Kuntz, 1967; Ryzhikov et al., 1985) rejected Wittenberg's genus *Southwellina*, Schmidt (1973) considered this genus as valid, and included the species *Arhythmorhynchus hispidus* in it as its type species. The author listed the following taxons as synonyms of *S. hispida*: *Arhythmorhynchus fuscus* Harada, 1929; *A. duocinctus* Chandler, 1935; *Polymorphus ardeae* Belopolskaia, 1958; and *Hemiechinoma ponticum* Petrochenko et Smogorjevskaia, 1962.

Taking into account morphological similarity of all the above mentioned taxa as well as a great variability of differential features used for their mutual distinguishing, particularly that of a number of hooks in longitudinal rows (see present data), we consider conclusions of Schmidt (1973) as correct.

In his classification of acanthocephalans, Amin (1985) accepted the opinion of Schmidt (1973) and listed *Southwellina* as valid genus.

The following fish-eating birds have been reported as definitive hosts of *S. hispida* in the literature: *Nycticorax nycticorax*, *Podiceps ruficollis*, *Ardea cinerea*, *Egretta intermedia*, *E. alba* and *E. garzetta*. Therefore, the common cormorant, *Phalacrocorax carbo*, represents a new definitive host of this parasite which has hitherto been found in Japan, USA, Taiwan, Russia

(Primorie, Crimea) (Schmidt, 1973; Ryzhikov et al., 1985).

There have only been two records of *S. hispida* in Europe: Macko (1964) found one female of *S. hispida* (under the name *Arhythmorhynchus hispidus*) from the intestine of heron, *Ardea cinerea*, in East Slovakia, and Dimitrova et al. (1990) reported the finding of *S. hispida* from *Egretta alba* in Hungary. Despite slight differences between measurements of Macko's specimen, acanthocephalans from Hungary and the present specimens from the common cormorant, caused apparently by somewhat larger size of the worms from herons, all the parasites seem to be conspecific.

Fishes *Rhinogobius* sp., *Mogurnda obscura* and *Carassius carassius*, the frog *Rana nigromaculata*, and the snake *Elaphe quadrivirgata* are considered as paratenic hosts (Petrochenko 1958).

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- Received October 2, 1992; accepted October 27, 1992

**NEW SPECIES OF THE GENUS BECKIELLA (ACARI: ORIBATIDA:  
DAMPFIELLIDAE) FROM PERU**

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**Abstract:** Two new species of the genus *Beckiella*, *B. inca* sp.n., and *B. latirostris* sp.n. are described and figured.

INTRODUCTION

Distribution of species of the genus *Beckiella* Grandjean is concentrated in the Neotropical region. Only *B. foliata* (Balogh & Mahunka) is recorded from Malaysia, other 26 species were recorded in the Neotropical region. Other 12 species of the family Dampfiellidae recorded from tropical Africa, South-East Asia, and the Pacific islands belong to the genus *Dampfiella* Sellnick. Only type *Dampfiella* species, *D. procera* Sellnick, was described from Mexico. Genus *Beckiella* and family Dampfiellidae were surveyed by Balogh & Mahunka (1978). Recently Balogh & Balogh (1987) surveyed *Beckiella* species from the Neotropical region.

Dr J. Błoszyk (Poznań, Poland) gave me oribatid material from Peru collected by his Polish colleagues. I found in this material two new species of the genus *Beckiella* which I described in this contribution.

*Beckiella inca* sp.n.  
(Figs. 1A-B, 2A-D)

**Diagnosis:** clavate sensillus with roughed head, four pairs of genital setae, one pair of adgenital ones. Seta ta absent, setae te and ti come together, longer than notogastral setae, long postanal tectum.

**Description:** Length of body 644µm, width of body 281µm, colour dull ochre yellow, cuticle without thick layer of cerotegument.

**Prodorsum** (Fig. 1A) comparatively slender rostrum, on oval anterior part, between rostral and lamellar setae and near anterior end of prodorsal costulae situated distinct foveolae. Rostral and lamellar setae bent inward, externally ciliated, rostral ones longer than lamellar ones. Exostigmatal setae well developed, smooth and equal in the length to interlamellar ones. Pore point well observable. Stalk of sensillus short, apically large, clavus of the sensillus broad, apical part covered with spines. Four pairs of very fine interbothridial maculae present.

**Notogaster** (Fig. 1A) comparatively broad, oval, smooth with well developed im porus and Gla. Nine pairs of smooth notogastral setae, setae te and ti 3-4 x longer than notogastral ones,

come together. Seta ta absent. Posteromarginal setae equal in the length. Epimeral region (Fig. 1B), first epimera with distinct sculpturae, epimeral chaetotactic formula 1-1-1-3, setae 1b, 2a and 3c longer than other epimeral ones.

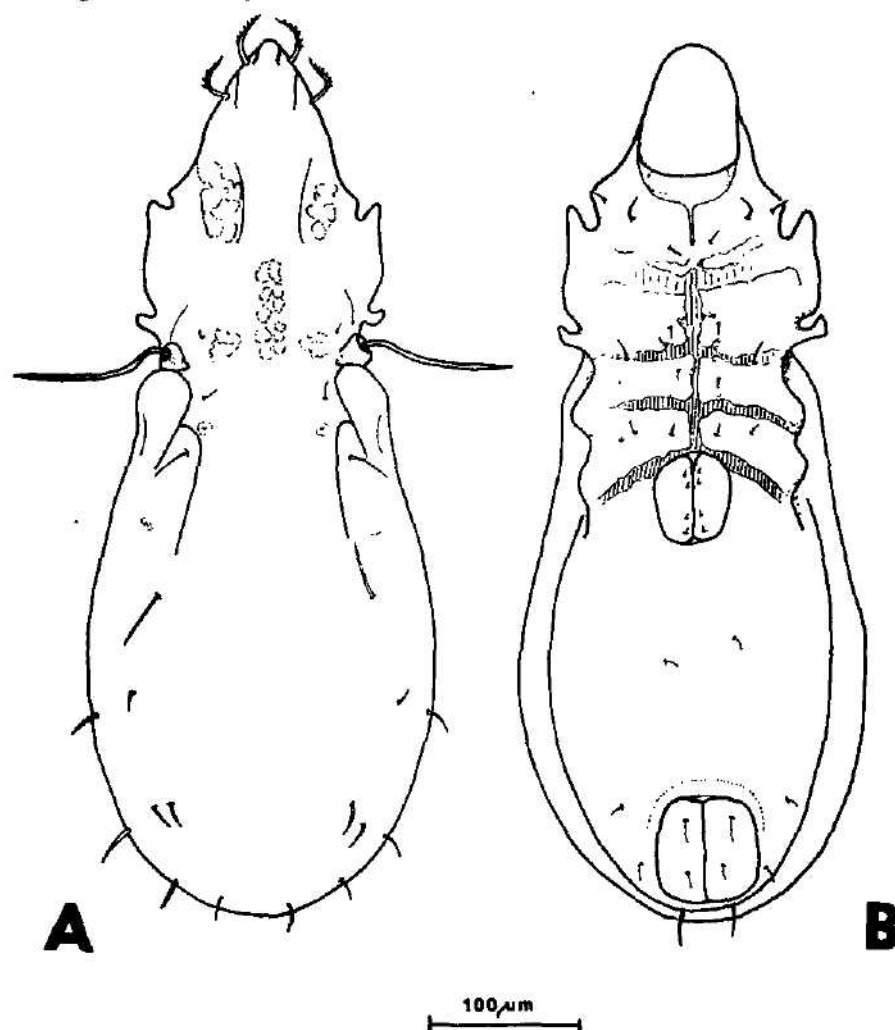


Fig.1 *Beckiella inca* sp.n., A - dorsal view on the body without legs, B - ventral view on the body without legs. Scale 100  $\mu$ m.

Anogenital region (Fig. 1B), genital plates elipsoidal with 4 pairs of minute genital setae. One pair of adgenital ones situated nearer to genital plates. Two pairs of minute anal ones, 3 pairs of longer adanal ones, seta ad3 in preanal position. Long postanal tectum present.

Legs (Figs. 2A-D), all monodactylous, leg chaetotaxy III 0-3-1/1/-2/1/-12-1, IV 0-2-2-2/1/-11-1-, femur I with 4 setae, femur II with 3 ones, trochanters I and II without ones. Tarsus III with 2 and tarsus IV with one corners. Seta d' on the femur III bifurcate.



**Affinities:** Only three *Beckiella* species have clavate sensillus with roughed head. All from Cuba, *B. duplicata* Balogh & Mahunka, *B. interlamellaris* Balogh & Mahunka they differ from new species by presence of long ta setae, and by two pairs of adgenital setae (Balogh & Mahunka, 1978). *B. cubana* Stary has short postanal tectum, only te setae are distinctly longer than other notogastral ones. Notogastral setae are shorter and finer (Stary, 1988).

**Locustypicus:** Peru, 1.9.1976, Macchu-Picchu, tropical rainforest, litter sample, leg. J. Michejda.

**Types:** Holotypus (Ho-1.9.1976-PR-008) in ethanol is deposited in the authors collection in the Institute of Soil Biology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia.

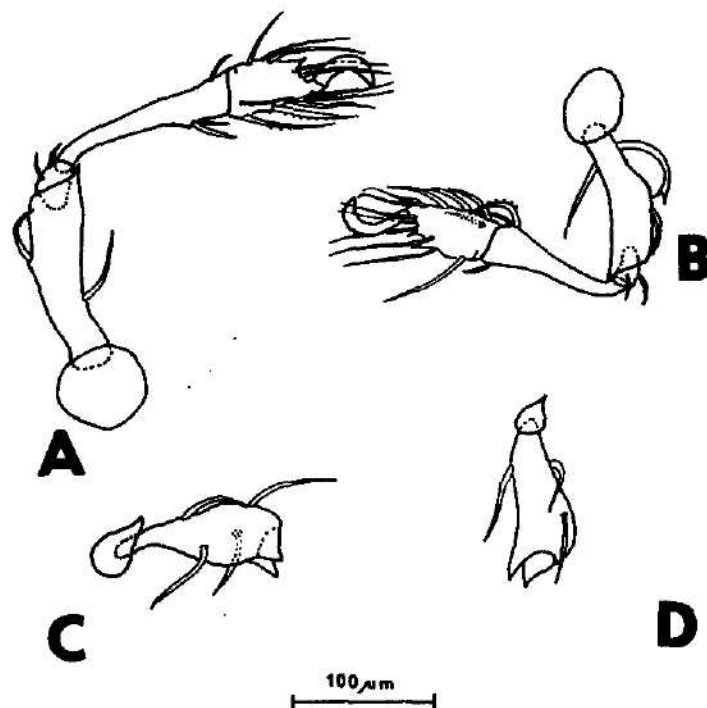


Fig.2. *Beckiella inca* sp.n., A - left leg IV in paraxial view, B - left leg III, in paraxial view, C - trochanter and femur of leg I in antiaxial view, D - right trochanter and femur of leg II in antiaxial view. Scale 100  $\mu$ m.

***Beckiella latirostris* sp.n.**

(Figs. 3A-B, 4A-D)

**Diagnosis:** extended posterolateral border of rostrum, smooth setiform sensillus, seta ta present, four pairs of genital ones, one pair of adgenital ones, long postanal tectum present, posteromarginal ones p1 and p2 distinct longer than p3 and r3.

**Description:** Length of body 674-775  $\mu$ m, width of body 284-325  $\mu$ m, colour yellowish-brown, cuticle without thick layer of cerotegument.

**Prodorsum** (Fig. 3A) anterior part of rostrum oval with fine foveolae and externally ciliated rostral and lamellar setae, rostral ones longer than lamellar ones. Distinct extension of posterola-

teral part of rostrum behind insertions of lamellar setae. Costulae and interbothridial maculae very fine, badly observable. Exostigmatal setae well-developed, equal in the length to interlamellar ones, pore point well-observable. Sensillus long, setiform and smooth with sharp top.

Notogaster (Fig. 3A) comparatively broad, ovoid with 10 pairs of notogastral setae with different length. Setae te the longest notogastral ones. Setae ms, r1, and r2 equal in the length, setae ti longer than ms but shorter than te. Distinct ta setae present, equal in the length to ms ones, Setae p1 and p2 3x longer than other posteromarginal ones and equal in the length to ti

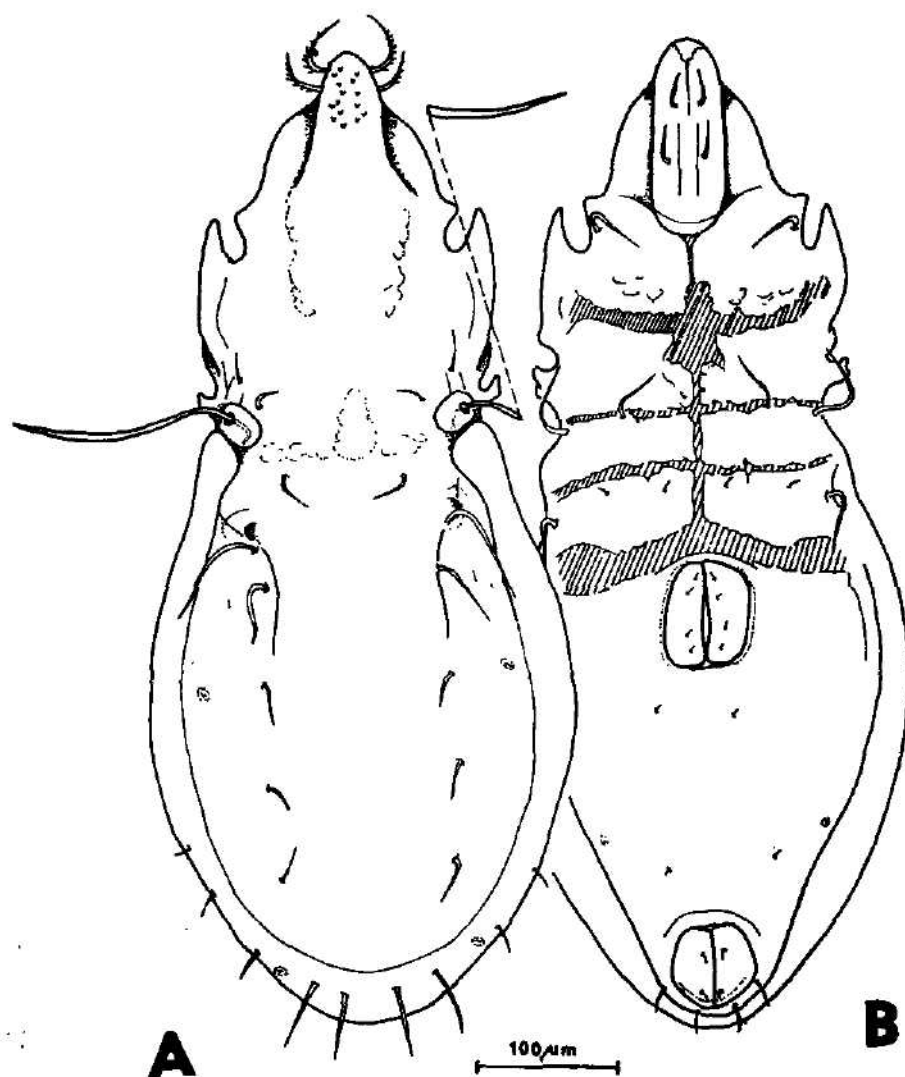


Fig.3. *Beckiella latirostris* sp.n., A - dorsal view on the body without legs, B - ventral view on the body without legs. Scale 100 μm.

ones. Gla and im pore well-observable. All surface of notogaster smooth without distinct sculpturae.

Epimeral region (Fig.3B), first epimera with fine sculpturae. Epimeral chaetotactic formula 1-0-2-3, setae 4a, and 4b minute and fine, distinctly shorter than other epimeral ones.

Anogenital region (Fig.3B), genital plates larger than anal ones, with 4 pairs of minute genital setae, two pairs of minute anal ones. One pair of minute adgenital setae situated nearer to

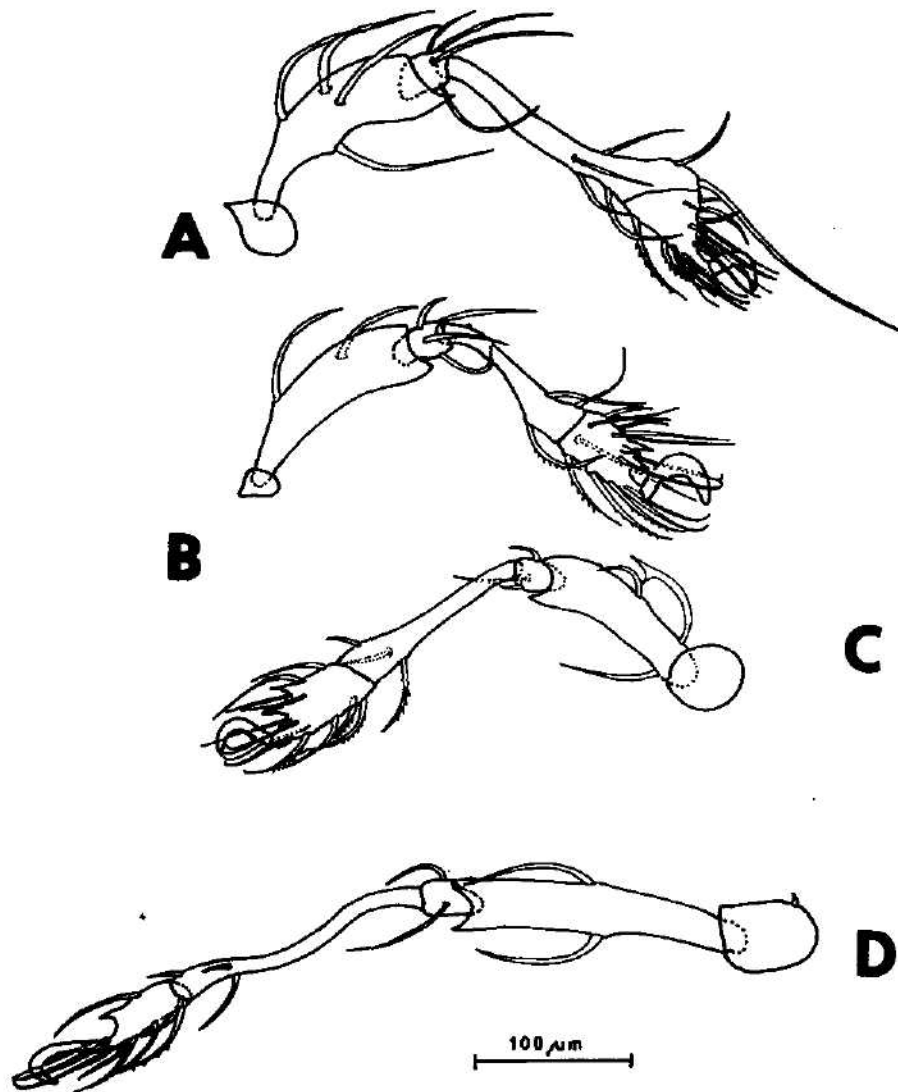


Fig.4. *Beckiella latirostris* sp.n., A - right leg I in antiaxial view, B - right leg II in antiaxial view, C - right leg III in paraxial view, D - right leg IV in paraxial view. Scale 100 μm.

genital plates than anal ones. Three pairs of adanal setae, seta ad3 in preanal position, minute, 2-3x shorter than postanal ad1 and ad2 ones. Long postanal tectum present.

Legs (Figs. 4A-D) long, and slender, all monodactylous. Leg chaetotaxy I 0-4-3/1/-4/2/12/2/-1, II 0-2-3/1/-2/1/-12/2/-1, III 0-3-2/1/-2/1/-13-1, IV 1-2-2-2/1/-9-1, tarsae III and II with two long corners, tarsae I and IV with one long one. Seta d'on the femur III bifurcated.

**Affinities.** The new species differs from congeners by the following combination of features: smooth setiform sensillus and extended lateral border of rostrum. The closest related species is *B. irmai* Balogh & Mahunka, which differs by longer te and ti setae, and by absence of ta ones. *B. elongata* Balogh & Mahunka, has shorter te and ti setae and p1 and p2 setae (Balogh & Mahunka, 1969). *B. sellnicki* (Hammer) has lanceolate sensillus and shorter ti setae (Hammer, 1961), *B. carinata* (Beck) has not extended rostrum (Beck, 1962).

**Locus typicus:** Peru, Macchu-Picchu, 1.9.1976, tropical rainforest, litter sample, leg. J. Michejda.

**Types:** Holotypus (Ho-1.9.1976-PR-008) in ethanol and three paratypes in ethanol are deposited in the Institute of Soil Biology, Czechoslovak Academy of Sciences, České Budějovice, Czechoslovakia, one paratype in ethanol is deposited in the Institute of Biology, A. Mickiewicz University, Poznań, Poland.

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# NEW SPECIES OF PALEARCTIC OSMIINI (HYMENOPTERA, APOIDEA, MEGACHILIDAE)

Bořek TKALCŮ

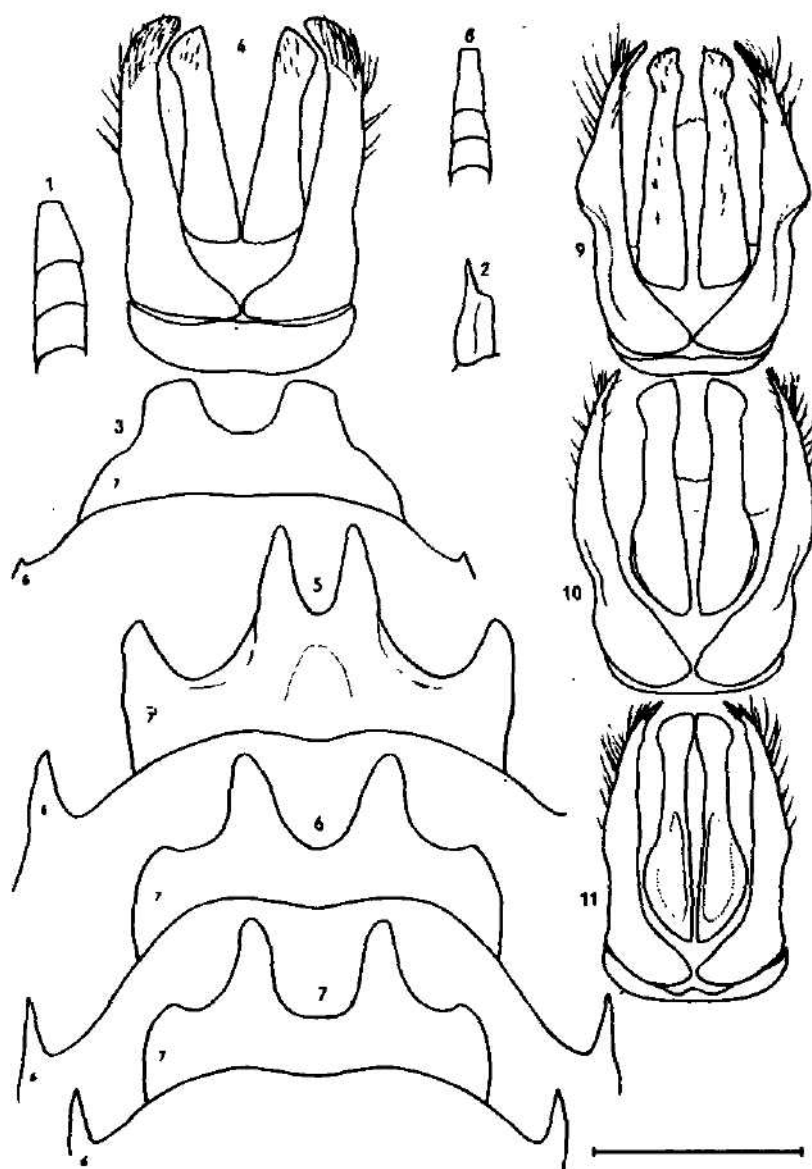
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**Abstract.** The following species are described: *Anthocopa* (*Anthocopa*) *alatauensis* sp. n. from Kazakhstan, *Anthocopa* (*Anthocopa*) *quadripina* sp. n. from Tunis, *Anthocopa* (*Anthocopa*) *cretaea* sp. n. from Crete [both latter species are closely related to *A. bisulca* (Gerstaecker, 1869) the lectotype of which is designated], *Anthocopa* (*Glososmia*) *murina* sp. n. from Turkmenistan, *Hoplitis* (*Hoplitis*) *semilinguaria* sp. n. from Iran [the holotype of the related *H. linguaria* (Morawitz, 1876) is studied and redescribed], *Hoplitis* (*Allosmia*) *imitatrix* sp. n. from Turkmenistan, *Hoplosmia* (*Hoplosmia*) *tyneri* sp. n. from Uzbekistan, *H.* (*Hoplosmia*) *elegans* sp. n. from Turkey, *Hoplosmia* (*Odontanthocopa*) *warncke* sp. n. from Iran, *Hoplosmia* (*Odontanthocopa*) *hermonensis* sp. n. from Israel and *Osmia* (*Chalcosmia*) *milena* sp. n. from Turkey.

## *Anthocopa* (*Anthocopa*) *alatauensis* sp. n.

**Holotype** ♂ "Asia c., USSR, Kazakhstan, Alma Ata-Medeo, 1700 m, Zailijskij Alatau Mts., 5. - 8. 7. 1980, P. Tymer", coll. Tymer. (Litvinov, ČSFR).

♂ - **Morphology:** Inner orbits slightly converging below. Mandibles tridentate. Mouth parts short. Maxillary palpi four-segmented. Segment 1 of labial palpi shorter than segment 2. Upper margins of lateral ocelli situated slightly above supraorbital line. Ocelloocular distance 670 µm, ocellooccipital distance 640 µm, diameter of lateral ocellus 210 µm. Punctuation of ocelloocular area dense and deep, penta- to hexagonal (15-25 µm), interspaces mostly edgily narrow, polished. Punctuation of vertex above supraorbital line coarser (40-50 µm), genal area with round punctures (30-35 µm), interspaces edgily narrow to one puncture width, polished. Proximal flagellar segments as in Fig 1. Median area of mesoscutum with dense round punctures (30-40 µm), interspaces edgily narrow to of one puncture width, polished; a narrow longitudinal area behind median stria scarcely punctate; punctuation on sides of mesoscutum finer, penta- to hexagonal, nearly confluent. Tegulae polished, with a few irregularly scattered minute punctures. Propodeal triangle polished except for feebly concave mediobasal triangular area dulled by roughening. Uncus of fore tibia relatively short, spine-like. Strigilis as in Fig. 2. Hind coxae rounded on inner ventral angle, without longitudinal carina. Hind basitarsi parallel sided. Tergite 1 with well developed gradulus, disappearing laterally, its ventrolateral portion without stria. Tergites polished with round punctures (25-30 µm) separated by more than one puncture width. Tergites 6 and 7 as in Fig. 3. Surface of sternites mostly polished. Sternite 2 with punctures separated by several puncture width, only subapically rather densely punctated, apical margin broadly arcuate. Sternite 3 with punctuation similar but more dense, with a faint narrow midapical



Figs 1-4. *Anthocopa alatauensis* sp. n., ♂; 1 - three basal flagellar segments of right antenna, 2 - Strigilis, 3 - apical margins of tergites 6 and 7, 4 - Genitalia in dorsal view. Fig. 5. *Anthocopa quadrispina* sp. n., ♂, apical margins of tergites 6 and 7. Fig. 6. Same of *Anthocopa bisulca* (Gerstaecker), ♂. Fig. 7. Same of *Anthocopa cretaea* sp. n., ♂. Figs 8, 9. *Anthocopa quadrispina* sp. n.; 8 - three basal flagellar segments of right antenna, 9 - male genitalia in dorsal view. Fig. 10. *Anthocopa bisulca* (Gerstaecker), male genitalia in dorsal view. Fig. 11. Same of *Anthocopa cretaea* sp. n. Scale = 1 mm.





♀ - Body length ca. 11 mm, length of fore wing 7.5 mm.

**I n t e g u m e n t :** Black. Dorsal surface of mandibula along shining apical margin slightly brown-red. Tegulae black, their outer portions but yellowish semitranslucent. Uncus of fore and mid tibiae, terminal tarsal segments and basal halves of claws paler reddish-yellow, their apical halves reddish-brown. Tibial spurs pale ochreous. Narrow preapical margins of sternites 1-5 yellowish. Membrane of fore wing as in male.

**P u b e s c e n c e :** moderately long, somewhat irregular, erect or nearly so for most parts. Head yellowish-white (frontovertex deep golden yellow in fresh specimens of *A. bisulca*); clypeus (except for loose hairs near apical margin), supraclypeal area, paraocular area and lower portion of frons densely pubescent (sculpture hardly visible); upper portion of frons and tempora with loose erect hairs (sculpture good visible); lower portions of tempora longer and more densely pubescent; hypostomal area with medially directed long stiff bent hairs. Dorsal surfaces of mandibles with very short appressed greyish pubescence, their outer margins with long pale greyish-brown bristles. Scapus but shortly semi-recumbent pubescent. Hairs of thorax dense, erect; those of mesoscutum, metanotum, scutellum, upper portions of mesepisterna and propodeum pale, dull yellow (dorsum of thorax deep golden-yellow in fresh specimens of *A. bisulca*), ventral part whitish. Legs whitish, bristles on inner surfaces of basitarsi golden-yellow; Tarsal segments 1-4 of fore and mid legs with arised shaggy hairs. Hind margins of hind tibiae with dense pubescence (sculpture only partly visible). Tergites with erect shaggy brownish-yellow hairs, preapical margins with bands of moderate width, consisting of appressed brownish-yellow hairs; aspect of tergite 6 black in general, its surface covered with short, inconspicuous semiappressed greyish pubescence. Sternal scopa dense and long, pale dull yellow.

♂ - Body length ca. 11.5 mm, length of fore wing 8 mm.

**I n t e g u m e n t :** black. Tegulae black, their outer portions but yellowish semitransparent. Uncus of fore and mid tibiae, terminal tarsal segments and basal halves of claws pale reddish-yellow, their apical halves reddish-brown; most of tarsal segments 4 reddish-yellow. Tibial spurs pale ochreous. Narrow apical margins of sternites 2-5 pale yellow; sternite 6 with broad preapical margin reddish. Membrane of fore wing nearly hyaline, marginal cell not infuscated along wing margin. Vains dark fuscous, narrower ones somewhat brownish-yellow, semitransparent.

**P u b e s c e n c e** (in general rather similar to ♀): head pale dull yellow (frontovertex deep golden-yellow in fresh specimens of *A. bisulca*), lower portions of tempora, genal area, and outer margins of mandibles whitish; pubescence of clypeus, supraclypeal area, and lower portion of frons rather long, erect to suberect, very dense (sculpture not visible), hairs near apical margin of clypeus gradually semiappressed, reaching over apical margin. Frontovertex in general with loose hairs (sculpture visible), but more densely pubescent on occiput and on vertex between ocelli-triangle and occiput. Hairs of thorax dense, erect, rather long, pale dull yellow (dorsum of thorax deep golden-yellow in fresh specimens of *A. bisulca*), ventral parts whitish. Legs whitish, bristles on inner surfaces of basitarsi golden-yellow. Pubescence of tergites 1-5 nearly as in female, marginal bands somewhat paler; hairs of tergites 6 and 7 but loose, dull yellow. Sternites 2-5 (namely laterally) with fringes consisting of rather long, soft, whitish hairs, bent medially on sternites 3-5; middle portion of sternite 3 with a small, ca. triangular patch consisting of very dense, short, appressed golden-yellow hairs; similar but a slightly larger patch on sternite 4, the

largest one on sternite 5. Sternite 6 near apical margin mostly with loose soft pale yellow hairs.

The specific name refers to the form of the tergite 7 of the male sex which is produced into four processes.

**Note:** Lectotype of *Osmia bisulca* Gerstaecker, 1869 by present designation: ♂ labelled as follows: 1) pale blue label, printed "Sicilien Zeller S.", 2) in Gerstaecker's handwriting "Sizilien Zeller"; coll. Zool. Mus. Berlin.

*Anthocopa (Anthocopa) cretaea* sp.n.

**Holotype:** ♂ labelled as follow: 1) "Sitia Kreta 17. 20. 5. 1963 leg. J. Gusenleitner", 2) "*Osmia bisulca* Gerst. o D. S. Peters det. 1974"; coll. author.

**Paratype:** 1 ♀ ditto.

(Both specimens were kindly sent for the collection of the author by Mr. F. Parré.)

This species resembles in both sexes *A. bisulca*, but differs by finer and widely spaced punctuation of propodeum near propodeal triangle; the brilliantly shining interspaces are here equal to more than double puncture width.

♂ - Inner pair of processes of tergite 7 somewhat shorter than in *A. bisulca*, their inner margins parallel-sided, deep emargination between them more U-shaped (Fig. 7) (V-shaped in *A. bisulca* - Fig. 6); disk of tergite 7 missing a median fossa. Sternites 2-4 each with tumescence lower than in *A. bisulca* and somewhat more scarcely punctured. Genitalia as in Fig. 11.

The specific name refers to the founding place - Crete.

*Anthocopa (Glosomia) murina* sp.n.

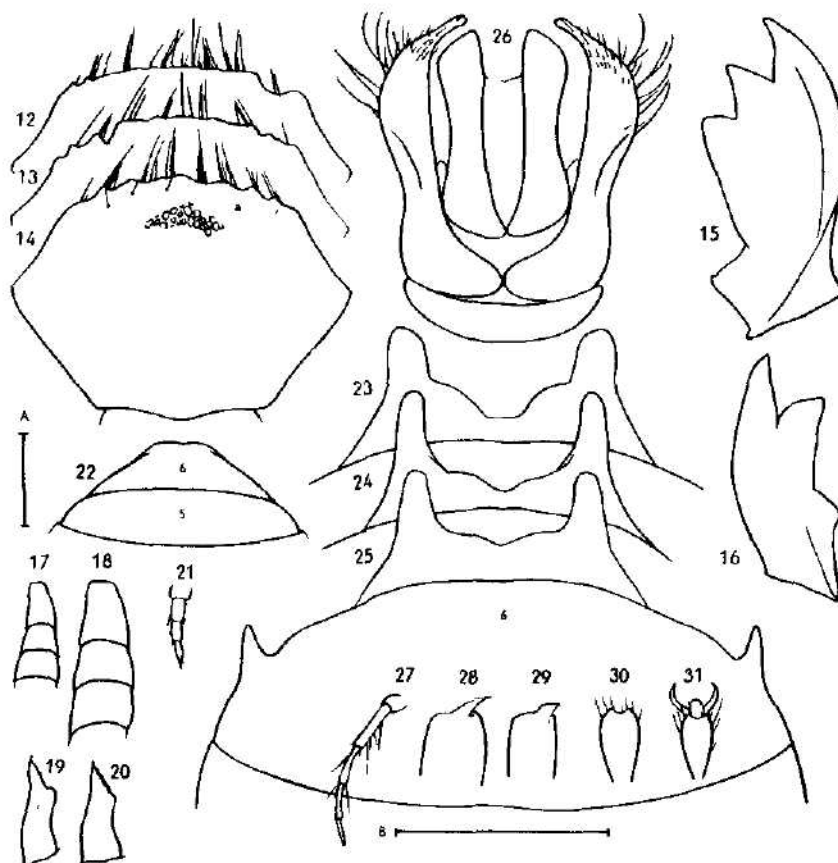
**Holotype:** ♂ "Turkmen. SSR, 1989, Kara Kala 29. - 3. 5., lgt. S. Bečvář"; coll. Halada (České Budějovice, ČSFR).

**Paratypes:** 3 ♀ and 3 ♂ with the same statements as for holotype (1 ♀ and 1 ♂ in coll. of the author). Turkmenistan: Kizyl - Arvad, 13. and 15. 5. 1953, 1 ♀ and 1 ♂, D. Panfilov lgt.; coll. v.d. Zanden.

In the female sex well defined by the shape of the clypeus and the tumescent scutellum; the males are easily recognizable mainly by the form of tergite 7 which is unique within the group and by their genitalia.

♀ - **M o r p h o l o g y:** Inner orbits in their lower 2/3 imperceptibly converging below. Mandibles tridentate (Fig. 15). Labrum relatively short, nearly quadrate, with apical margin shallowly emarginated. Mouth parts of moderate length; maxillary palpi short, 4-segmented (Fig. 21); segment 2 of labial palpi nearly three times longer than segment 1. Upper margin of lateral ocelli touching supraorbital line. Ocelloocular distance 610 µm, ocellooccipital distance 640 µm, diameter of lateral ocellus 175 µm. Clypeus as in Figs. 12-14, surface feebly convex, with penta- to hexagonal punctures coarse and deep (30-50 µm), sharply delimited, their interspaces very narrow, only here and there to a half puncture width, polished; anterior clypeal margin straight or nearly so, irregularly and asymmetrically serrate, with a broad (100-110 µm) adjacent transverse area polished and impunctate. Supraclypeal area slightly finer punctured, imperceptibly longitudinally concave, its narrow longitudinal portion with wider polished interspaces. Frontoververtex with punctuation mostly coarse and deep (30-50 µm), sharply delimited, their interspaces very narrow, only rarely to ca. one puncture width, polished. Punctuation of genal area more dense and regular, finer (30-40 µm), more shallow. Proximal segments of flagellum as in Fig. 17. Punctuation of mesoscutum crowded, sharply delimited, penta- to hexagonal (50 µm), but

rather shallow, interspaces edgily narrow. Scutellum strongly convex, forming a median conical bulge narrowly rounded above, with punctation similar to that on mesoscutum but slightly finer. Tegulae polished, with irregularly scattered round punctures (25-30  $\mu\text{m}$ ), interspaces very narrow to 2 puncture width. Propodeal triangle polished except for a narrow basal transversal pitted zone distinctly impressed medially. Adjacent portion of propodeum with fine round, sharply delimited punctures (15-25  $\mu\text{m}$ ), interspaces narrow to little more than one puncture width, polished. Uncus of fore tibia short, flattened bilaterally, with a sharply elevated dorsal keel. Strigilis as in Fig. 19. Hind coxae with only a feeble suggestion of a ventral longitudinal carina.



Figs 12 - 26. *Anthocopa murina* sp. n.; 12-14 - clypeus, ♀ (a = impunctate polished area along apical margin), 15 - right mandibula, ♀, 16 - left mandibula, ♂, 17 - three basal flagellar segments of right antenna, ♀, 18 - same of ♂, 19 - strigilis, ♀, 20 - same of ♂, 21 - palpus maxillaris, ♀, 22 - tergites 5 and 6, ♀, 23 - 25 - apical margins of tergites 6 and 7, ♂ (25 holotype), 26 - male genitalia in dorsal view (holotype). Figs. 27, 28. *Hoplitis linguaria* (Morawitz), ♀ (holotype); 27 - palpus maxillaris, 28 - apex of right protibia in dorsal view. Fig. 29. *Hoplitis semilinguaria* sp. n., ♀, apex of right protibia in dorsal view. Fig. 30. *Hoplitis rufohirta* (Latreille), ♀, terminal segment of tarsus. Fig. 31. same of *Hoplitis imitatrix* sp. n., ♀. Scale = 1 mm (scale A for Fig. 22 only, scale B for others).

Tergite 1 with well developed gradulus, disappearing laterally, its ventrolateral portion without stria; dorsal surface with punctation rather regular, round, sharply delimited (30-40  $\mu$ m), interspaces narrow to one puncture width. Punctation of middle portions of tergites 2 and 3 distinctly wider spaced, that on transverse premarginal portions of tergites 1-5 being finer (15  $\mu$ m) and more crowded. Tergite 6 regularly covered with small punctures (15  $\mu$ m), separated by very narrow, somewhat indistinctly shagreened interspaces, apical margin broadly rounded with an imperceptible narrow emargination medially (Fig. 22).

Body length ca. 9 mm, length of forewing 7 mm.

**I n t e g u m e n t :** Black. Mandibles with subapical portion reddish-brown. Labrum in basal half dull ochreous, becoming darker reddish-brown apically. Tegulae blackish, along their outer margins but broadly brown-yellow, semitranslucent. Tibial spurs ochreous. Terminal segments of tarsi blackish-brown. Forewing membrane nearly hyaline; venation dark brown, costal margin but distinctly pale ochreous. Nervulus nearly perpendicular, interstitial or slightly antefurcal. Abscissa A of the cubital cell 2 nearly as long as or slightly longer than abscissa B.

**P u b e s c e n c e :** Relatively short, uniformly greyish over entire body. Loose tufts of bristles arising beneath apical margin of clypeus and inner surfaces of basitarsi golden-yellow. Tergites 2-5 with very short erect and inconspicuous pubescence, tergite 6 nearly bare. Tergites 1-5 each with sharply delimited and continuous apical fasciae consisting of dense recumbent white hairs. Sternal scopa rather long, whitish.

**♂ - M o r p h o l o g y :** Inner orbits in their lower 2/3 slightly converging below. Mandibles bidentate (Fig. 16). Labrum similar as in female; its basal 2/3 nearly devoid of punctures (except for lateral margins) and strongly shining; remaining apical part densely covered with small fine punctation. Mouth parts as in female. Upper margins of lateral ocelli touching supraorbital line. Ocelloocular distance 510  $\mu$ m, ocellooccipital distance 655  $\mu$ m, diameter of lateral ocellus 190  $\mu$ m. Clypeus regularly covered with small confluent punctures (20  $\mu$ m), surface dull (sculpture in fresh specimens hardly visible, as covered with dense pubescence throughout), anterior margin straight, irregularly serrate.

Maximum width of flagellum in segment 2. Proximal segments of flagellum as in Fig. 18. Sculpture of head and thorax rather similar to that of female, scutellum more flattened. Strigilis as in Fig. 20. Hind coxae and gradulus of tergite 1 as in female. Pregradular area of tergites 2-6 dull, shagreened, with irregular small and shallow punctures; exposed surfaces of tergites 1-6 otherwise with sculpture similar to that of female; tergite 6 with a distinct impunctate polished belt along its apical margin. Apical margins of tergites 6 and 7 as in Figs. 23-25. Apical margin of sternite 1 broadly straight, rounded laterally; sternite 2 with bilateral thirds strongly converging and median third straight. Apical margins of sternites 3 and 4 very weakly arcuate. Sternite 5 with basal membrane, its apical margin straight, rounded laterally. Sternite 6 with basal bilateral membrane, its apical margin produced semicircularly; surface covered with small punctures (15  $\mu$ m) separated by ca. one puncture width; its broad, shallowly concave midapical area, crescently delimited on front, impunctate (except for a few scattered, sharply delimited small punctures basally), strongly shining except for feeble reticulate portion along apical margin which is provided with a small but very distinct ovate tumescence midsubapically. Genitalia as in Fig. 26.

Body length ca. 12 mm, length of forewing 7 mm.

**I n t e g u m e n t :** Similar to the female. Labrum not lightened. Apical margin of tergite<sup>5</sup> brownish yellow, semitranslucent. Genitalia intensively yellowish brown, apices of gonostyl<sup>1</sup> dark brown.

**P u b e s c e n c e :** In general aspect similar to that of female but relatively longer and more uneven; on head, thorax above and tergite 1 drab yellow in fresh specimens. Sternites 2-5 each having loose long recumbent hairs along apical margin.

*Hoplitis (Hoplitis) linguaria* (Morawitz, 1876)

**H o l o t y p e** (studied in 1986): ♀ (nearly fresh) labelled as follows: 1) in ink "Azchur", 2) printed in Cyrillic alphabet "K. F. Moravica", 3) in Chinese ink "*Osmia linguaria* Mor.", 4) red label, printed "Holotypus"; coll. Zool. Inst. Sankt Peterburg

Condition very good; only left flagellum missing. Nevertheless, the holotype is not "ein sehr abgeflogenes Exemplar" as stated in the original description by Morawitz: the pubescence (namely that on the tergites) is more or less rubbed off, but the apical margins of the fore wings are nearly intact.

Additional descriptive notes based on the holotype: Shining interspaces between punctures on clypeus very narrow to equal half puncture width, here and there with scattered minute punctures. Clypeus mediobasally with ca. triangular impunctate area approximately equal to ocellus diameter in its extent; disk in its lower 2/3 with narrow shining median line, laterally along suture between clypeus and paraocular area with longish impunctate and shining portions of similar amount. Inner orbits very distinctly diverging below. Morawitz's statement "das Mittelfeld der hinteren Thoraxwand seidenglänzend" is merely somewhat global; propodeal triangle is coarsely roughened basally indeed, most of its portion is evenly shagreened, along sides but distinctly shining. Interspaces between punctures on propodeum and on basal concave portion of tergite 1 polished. Mesosternum as described by Morawitz, with widely spaced fine punctures (interspaces ca. of double puncture width). Tegulae and tibial spurs drab yellow ("rötlich" as Morawitz). Hind coxa with a sharp carina on ventral inner angle. Nervulus of fore wing antefurcal.

*Hoplitis (Hoplitis) semilinguaria* sp. n.

**H o l o t y p e :** ♀ (nearly fresh) labelled as follows: 1) "SW Iran, Pol-e-Tang, 60 km NW Andimeshk, 10. 11. 4. 1977", 2) "Loc. no 284 Exped. Nat. Mus. Praha"; coll. Nat. Mus. Prague.

Paratypes: 8 ♀ detto (3 ♀ in coll. of the author).

♀ - Body length ca. 8 mm.

*H. linguaria* (Mor.)

Inner orbits very distinctly diverging below.  
Supraclypeal area generally somewhat coarsely punctate, punctures widely spaced medially.

Ocellooccipital distance 530 µm, ocelloocular distance 480 µm.

*H. semilinguaria* sp.n.

♀

Inner orbits parallel-sided throughout.  
Supraclypeal area generally somewhat finer punctate, only medially a little more widely (punctures separated by one puncture width).

Ocellooccipital distance 400 µm, ocelloocular distance 430 µm.

Punctuation of frontovertex coarser and less dense; interspaces very narrow to equal to one puncture width, here and there with scattered minute punctures.

Punctuation of mesoscutum and scutellum somewhat coarser and less dense.

Propodeal triangle as given in the redescription above.

Propodeum near triangle shining.

Hind coxa with sharp carina on ventral inner angle. Uncus of fore and mid tibia rather long and thin (Fig. 28).

Hind tibia sharply pointed dorsoapically.

Punctuation of tergites more widely spaced (very distinctly so on tergites 2 and 3 medially).

Ground between punctures in postgradular portions of tergites 4 and 5 shining.

Punctuation of sternites distinctly finer and more dense; ground between punctures shining.

Flagellar segments 2, 3 and 4 (segment 5 not very distinctly) brownish-yellow.

Punctuation of frontovertex finer and distinctly more dense; interspaces very narrow, without any scattered punctures.

Punctuation of mesoscutum and scutellum somewhat finer and more dense.

Propodeal triangle finely and sharply shagreened throughout (without a pitted transversal zone medio-basally).

Propodeum shining, with ill-defined shagreening.

Hind coxa without such a carina. Uncus of fore and mid tibia short and wide (Fig. 29).

Hind tibia rounded dorsoapically.

Punctuation of tergites denser in general.

Ground between punctures in postgradular portion of tergites 4 and 5 shagreened throughout.

Punctuation of sternites coarser and more widely spaced; ground between punctures shagreened.

Flagellar segments 3-9 and basal half of terminal segment ochreous below.

The specific name alludes to the similarity to *H. linguaria*, inclusive its extremely long mouth parts.

*Hoplitis (Allosmia) imitatrix* sp.n.

H o l o t y p e : ♀ "Turkmen, SSR, 1989, Kara-kala, 29. - 3. 5., lgt. S. Bečvář"; coll. Halada (České Budějovice, ČSFR).

Generally the new species has the aspect of a small-sized *H. rufohirta* (Latreille, 1811) but differs from it as follows:

*H. rufohirta* (Latr.)

Terminal segments of tarsi in dorsal view somewhat swollen (Fig. 30); their integument dark brown, becoming brownish-yellow only apically.

Forewing with abscissa A and B of the cubital cell 2 equal in length.

Punctuation of tergites denser; broad premarginal transverse areas of tergites 2-4 with less fine punctures (25 µm) separated by less than one puncture width.

Coloration of pubescence bright rufescent.

Body length 8-9 mm.

*H. imitatrix* sp.n.

Terminal segments of tarsi in dorsal view hardly swollen (Fig. 31); their integument distinctly paler, brown-yellow for the whole surface.

Abscissa A very short, abscissa B twice as long as abscissa A.

Punctuation of tergites less dense; broad premarginal transverse areas of tergites 2-4 with only fine punctures (15 µm) separated medially by more than two puncture width.

Coloration of pubescence dull ochreous in fresh specimens

Body length 7.5 mm.

The specific name alludes to the similarity to *H. rufohirta* (Latr.).



*Hoplosmia (Hoplosmia) tyneri* sp.n.

Holotype: ♂ "Asia c., Uzbekistan, USSR, Taškent, env., Galvasai, 25. 6. 1980, P. Tyner leg."; cf. Tyner (Litvinov, ČSFR).

Paratypes: 1 ♂ deto in coll. of the author. Uzbekistan: Chatkal Mts., 800 m. 70 km NE Tashkent, Galvasai, 25. - 28. 6. 1981, 1 ♂, Karel Majer lgt; coll. Tyner.

♂ - Body length ca. 5.5 mm.

*H. spinulosa* (Kby.)

*H. tyneri* sp.n.

♂

Punctuation essentially finer.

Hairless portions of tegulae with distinct and somewhat widely spaced punctures.

Terminal part of gonostylus more sharply pointed; outer margin subapically more rounded (cf. Fig. 109 in Tkalců, 1974: 124).

Integument coloured as in *H. spinulosa* (Kirby, 1802), but the claws dark with only terminal parts yellowish-brown.

Pubescence: In length, density and general aspect as in *H. spinulosa*, but (even on absolutely fresh specimens) greyish white throughout, apical bands of tergites snow-white.

Note: Obviously both species are sympatric in Middle Asia: 1 ♂ (absolutely fresh) of *H. spinulosa* from Kazakhstan, Medeo near Alma Ata, 1900-2000 m, 22. 4. lgt. Muche, coll. author and 1 ♂ from Kirghizia, Frunze, Aktu-Saj, 10. 6. 1989, lgt. Kletečka, coll. Halada prove to be in all specific characters inclusive their colour-pattern identical with the European population.

The new species is named for the collector.

*Hoplosmia (Hoplosmia) elegans* sp.n.

Holotype: ♂ from Turkey "TR, Side, 8. - 20. 6. 1985, Malaise-Falle, leg. Mohr."; coll. v.d. Zanden (Leiden).

Paratypes: ♀ detto; tibia and tarsus of right hind leg missing. Otherwise both specimens are absolutely fresh. Prov. Mugla Torba (Budrum), 17.-31.6. 1985, 1o, lgt. Probat; coll. v.d. Zanden.

A remarkable species, closely allied to *H. spinulosa* (which is sympatric with it in Turkey) but sharply differing from it in both sexes by the coarse and more crowded punctuation for the entire body and the mostly white, extremely short and even pubescence, partly appressed and nearly squamouse in some portions.

*H. spinulosa* (Kby.)

*H. elegans* sp. n.

♀

Occiput in frontal view more elevated medially.

Upper margin of lateral ocelli touching supraorbital line; ocelloocular distance 480 µm, ocellooccipital distance 640 µm.

Punctuation of supraclypeal area only slightly finer (30-50 µm) than that on basal part of clypeus (50-65 µm).

Interspaces of dorsal surfaces of mandibles polished.

Punctures of mesoscutum round to obtusely penta- to hexagonal (65/80µm), shining interspaces narrow, on median portion here and there nearly to one puncture width.

Occiput in frontal view more flattened medially.

Upper margin of lateral ocelli situated well below supraorbital line; ocelloocular distance 480 µm, ocellooccipital distance 720 µm.

Punctuation of supraclypeal area distinctly finer (30 µm) than the coarse punctuation of basal half of clypeus (65-80 µm).

Interspaces of dorsal surfaces of mandibles finely chagreened.

Punctures of mesoscutum sharply penta- to hexagonal (80 µm), interspaces mostly edgily narrow, only here and there slightly wider.



Propodeal triangle polished along lateral sides and below.

Body length 7-7.5 mm.

Propodeal triangle obscured by minute sharp reticulation throughout.

Body length 8 mm.

♂

Upper margins of lateral ocelli positioned slightly above supraorbital line; ocelloocular distance 415  $\mu$ m, ocellooccipital distance 530  $\mu$ m.

Sculpture of mesoscutum and scutellum similar to that of female.

Subapical margin of tergite 5 lacking the character of the opposite species. (At most with imperceptible flattened cuticular tubercles only laterally).

Midapical process of tergite 7 in dorsal view as in Fig. 95 in Tkalců (1974: 123).

Spine of sternite 1 more slender.

Body length ca. 8 mm.

Upper margins of lateral ocelli positioned below supraorbital line; ocelloocular distance 400  $\mu$ m, ocellooccipital distance 720  $\mu$ m.

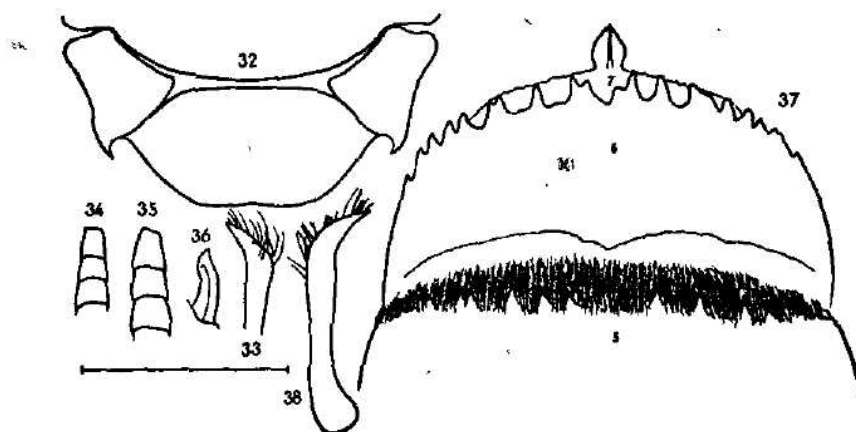
Sculpture of mesoscutum and scutellum similar to that of female.

Subapical margin of tergite 5 in front of marginal hair-band provided with a transverse row of irregularly arranged semirecumbent, strongly shining cuticular spines (Fig. 37).

Midapical process of tergite 7 in dorsal view as in Fig. 37.

Spine of sternite 1 more robust.

Body length little longer than in opposite species.



Figs 32-33. *Hoplosmia tyneri* sp. n., ♂, scutellum, 33 - gonostylus of male genitalia in dorsal view. Figs. 34-38. *Hoplosmia elegans* sp. n.; 34 - three basal flagellar segments of right antenna, ♀, 35 - same of ♂, 36 - strigilis, ♂, 37 - tergites 5-7, ♂, 38 - gonostylus of male genitalia in dorsal view. Scale = 1 mm.

♀ - Pubescence: Clypeus sparsely covered with very short and inconspicuous semirecumbent hairs (65-95  $\mu$ m) weakly branched, whitish on basal portion, becoming golden yellow and simple or nearly so toward apical margin. Preapical margin of clypeus bordered by transverse fringe of short golden-yellow recumbent hairs. Uppermost part and portions adjacent to paraocular area provided with scattered branched white hairs (160  $\mu$ m); a row of short tufts of golden-yellow bristles arising beneath clypeal apical margin. Supraclypeal area with very short feathered semirecumbent white hairs (65-85  $\mu$ m) directed medially; its lower triangular portion seeming bare in general aspect, virtually covered with extremely short simple hairs hardly visible. Paraocular area rather densely covered with semirecumbent branched white hairs (300  $\mu$ m).

KASPOLE  
Gzochos, C

arising radially from antennal sockets toward inner orbits; pubescence on lower portion of frons similar but longer and directed upward. Vertex nearly bare for the most part [virtually with scattered, extremely short and inconspicuous reddish-brown semierect simple hairs (80  $\mu$ m) arising from bottoms of coarse confluent punctation and directed downward] except for a few longer erect hairs (160-300  $\mu$ m) between lateral ocelli; narrow transversal portion along occipital margin rather densely covered with short plumose erect to semierect white hairs (110-160  $\mu$ m), nearly squamose; pubescence on genal areas similar but semirecumbent, directed toward outer orbits and becoming gradually shorter near them. Short velvety semirecumbent pubescence in front of apical margins of mandibles brownish, tending to be dark golden-yellow in some lights. Mesoscutum and scutellum seeming bare for the most parts (virtually covered with scattered, extremely short semierect reddish simple hairs inconspicuous and visible only in profile), mesoscutum but with very dense branched semisquamose creamy pubescence concentrated narrowly along anterior margin (here connected with similar pubescence of lateral parts of pronotum, its lateral lobes and of area just below wing bases), lateral and posterior margins; scutellum with similar pubescence on posterior margin only; axillae with scattered short semisquamose erect whitish hairs. Mesepisternum with short recumbent branched white hairs, on upper and lower portions seeming bare (virtually covered with inconspicuous very short simple hairs). Metepisternum above and propodeum except for triangular area densely covered with branched white hairs. Pilosity of legs in general aspect similar as in *H. spinulosa*, but markedly shorter; outer surface of hind tibiae with short semisquamose hairs widely spaced, but with very dense ones along posterior margin. Hairs of legs whitish, but golden-yellow on trochanters and femora of middle and hind legs beneath, on inner surfaces of tibiae and tarsi as well on outer surfaces of basitarsi of hind legs. Surfaces of tergites extensively seeming bare, virtually covered with inconspicuous extremely short (80  $\mu$ m) semierect (seen in profile) greyish-brown simple hairs; extreme sides and ventrolateral portions of tergites 1-5 rather densely covered with markedly long simple white pubescence. Apical margins of tergites 1-5 provided with snow-white bands of moderate width consisting of dense recumbent feathered hairs, broadly interrupted medially on tergites 1-3 and disappearing laterally on tergites 4 and 5. Short apical fringe of tergite 6 pale golden-yellow. Scopal hairs bright golden-yellow, dense and long except for sternite 6.

♂ - P u b e s c e n c e in general aspect very similar to that of female. Clypeus and supraclypeal area with dense and relatively long white pubescence (sculpture mostly not visible). Dorsal surfaces of mandibles without velvety pubescence. A row of short tawny bristles arising beneath clypeal margin present. Hypostomal area rather densely covered with erect branched white hairs. Pubescence of dorsal surfaces of thorax as in female. Sides of thorax with pilosity similar to that of female but mesepisternum with only a single area seeming bare, situated in its upper portion. Pilosity of legs similar to the female but trochanters and femora whitish beneath. Pilosity of tergites also similar but single hairs on lateral and ventrolateral portions less conspicuous and considerably shorter. Apical snow-white hair-bands continuous on tergites 1-6 but those on tergites 1-2 slightly narrowed medially and on the succeeding tergites disappearing laterally. Sternites fringed with white fasciae.

The specific name alludes to the elegant general appearance of the imagines.

*Hoplosmia (Odontanthocopa) warncketi* sp. n.

**Holotype:** ♂ "Iran, 17-V-78, 1800 m, 15 km SE Sarvestan/Parz, leg. K. Warncke"; coll. Warncke (Vierkirchen, Germany).

**Paratypes:** 1 ♂ deto; coll. author. Turkey: "TK-deti, Simak/Siri, 5. VI. 1977, leg. K. Warncke"; 1 ♂, coll. Warncke.

A species closely related to *H. ligurica* (Morawitz, 1868); The main differences are as follows:

*H. ligurica* (Mor.)

Vertex shorter; ocellooccipital distance 530 µm, ocelluloocular distance 530 µm.

Mouthparts relatively shorter (as in Fig. 88 in Tkalcá, 1974: 121); segment 3 of labial palpi distinctly shorter than length of composed eye.

Metanotum medially with but low obtuse tumescence.

Males of fore tibia spine-like (Fig. 42).

Apical margin of tergite 7 narrower (Fig. 105 in Tkalcá, 1974: 123).

Punctuation of body finer in general.

Genitalia as in Fig. 117 in Tkalcá (1974: 124); dorsal surface of gonostylus more flattened.

Membrane of fore wing nearly hyaline, only narrow apical margin (due to crowded papillae) slightly infuscated; marginal cell slightly infuscated with brown along wing margin. Hind wing hyaline throughout.

Pubescence (in European population) pale dull yellowish-brown.

Hairs-bands of tergites 1-5 merely ill-defined, loose and inconspicuous.

*H. warncketi* sp. n.

♂

Vertex longer; ocellooccipital distance 770 µm, ocelluloocular distance 560 µm.

Mouthparts relatively longer (Fig. 40); segment 3 of labial palpi as long as length of composed eye.

Metanotum medially sharply pointed as seen in profile (Fig. 41).

Males of fore tibia angular distally (Fig. 43).

Apical margin of tergite 7 broader (Fig. 45-47); median small notch sometimes but ill-defined.

Punctuation much coarser in general.

Genitalia as in Fig. 48; dorsal surface of gonostylus more swollen.

Membrane of fore wing nearly hyaline but apical 2/5 inclusive of marginal cell rather deeply infuscated with greyish-brown. Hind wing hyaline, with apical corner distinctly stained with greyish.

Pubescence (even in fresh specimens) pure white.

Hairs-bands of tergites 1-5 (that of tergite 1 rather narrowed or scarcely interrupted medially) more conspicuous and dense.

The species is named for the collector.

*Hoplosmia (Odontanthocopa) hermonensis* sp. n.

**Holotype:** ♂ labelled as follows: 1) "Israel, 1700 M, Mt. Hermon, 11. VI. 1976, D. Simon", 2) "Museum Leiden ex coll. G. van der Zanden".

**Paratypes:** 1 ♂ with the same label as the holotype, but coll. Tel-Aviv University. "Israel, 1700 m, Mt. Hermon, 8. VI. 1975, A. Friedberg", 2 ♂; one of these both labelled "Museum Leiden ex coll. G. van der Zanden", the other one in coll. Tel-Aviv University.

A species closely related to *H. distinguenda* (Tkalcá, 1974); the main differences are as follows:

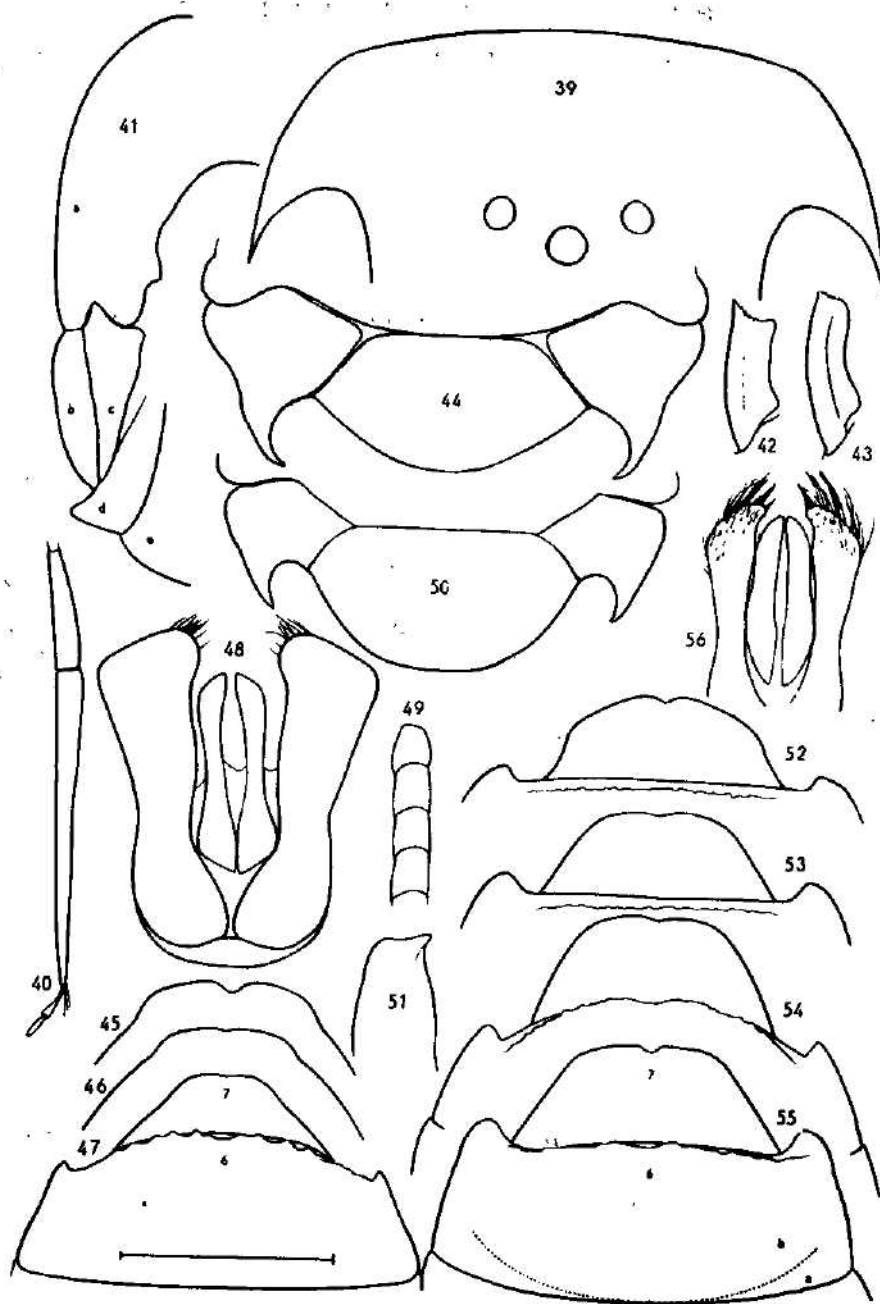
*H. distinguenda* (Tk.)

Lateral processes of tergite 6 less prominent. Apical margin of tergite 7 deeply emarginated medially (Fig. 103 in Tkalcá, 1974: 123).

*H. hermonensis* sp. n.

♂

Lateral processes of tergite 6 more prominent. Apical margin of tergite 7 rather evenly rounded, with but a small shallow notch medially (Fig. 52-55).



Surfaces of tergites 5 and 6 between gradulus and apical tergal edge rather homogenous, with strongly shining interspaces between the punctures throughout; the impressed basal transversal zone just behind gradulus less sharply delimited, narrow.

Genitalia as in Fig. 115 in Tkalců (1974: 124) more compact; outer margin of terminal part of gonostylus only with rather short pubescence.

Body length ca. 7.5 mm.

Tegulae dark (brownish-black) throughout, not translucent.

Integument of tergite 7 more distinctly reddish-brown.

Surfaces of tergites 5 and 6 each divided into two transversal zones between gradulus and apical tergal edge: a) sharply impressed basal zone finely roughened and dull between punctures which is approximately half as broad as the distance between gradulus and apical tergal edge and b) distal zone with strongly shining interspaces (Fig. 55).

Genitalia (Fig. 56) more extended; outer margin of terminal part of gonostylus with relatively very long pubescence.

Body length ca 9 mm.

Tegulae in outer halves markedly paler, brownish-yellow, semitranslucent.

Integument of tergite 7 less distinctly reddish-brown.

The specific name refers to the founding-place - Mt. Hermon in Israel.

**Note:** in the closely related *H. bidentata* (Morawitz, 1876) there is a distinct roughened basal zone (similar to that of *H. hermonensis* sp. n.) which proves to be an excellent specific character separating *H. distinguenda* from *H. bidentata*.

### *Osmia (Chalcosmia) milenae* sp. n.

**Holotype:** ♂ Turkey, Mus, 1.6.1972; coll. Özbek (Erzurum).

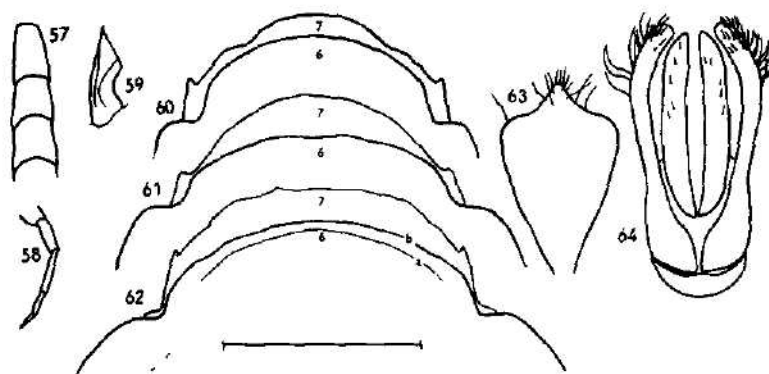
**Paratypes:** Mus, 15.5.1970, 1 ♂; coll. Özbek; 1.6.1972, 1 ♂; coll. author.

A metallic coloured species of a general *Chalcosmia*-aspect, characterized mainly by the form of the apical margins of the tergites 6 and 7, as illustrated in figs. 60-62.

**♂ - Morphology:** Inner orbits slightly converging below in their lower 2/3. Mandibles bidentate. Maxillary palpi five-segmented (Fig. 58). Segment 1 of labial palpi slightly shorter than segment 2. Malar space very short. Upper margins of lateral ocelli touching supraorbital line. Ocelloocular distance exactly as long as ocellooccipital distance (640 µm), diameter of lateral ocellus 190 µm. Clypeus distinctly convex in profile, with crowded, sharply delimited penta- or hexagonal punctures (30 µm), separated by interspaces edgily narrow; apical margin broad, imperceptibly arcuate or nearly straight and irregularly and asymmetrically obtusely serrate. Punctuation of paraocular area similar, with interspaces slightly wider, that of supraclypeal area slightly finer. Punctuation of front similar to that of clypeus, that of vertex and genal area slightly coarser (30-45 µm), with interspaces very narrow and strongly shining. Proximal flagellar segments as in Fig. 57. Mesoscutum with crowded, sharply delimited penta- or hexagonal punctures (30 µm) separated by interspaces edgily narrow, on median portion with punctuation a

Figs. 39-41, 43-48. *Hoplosmia wamckeii* sp. n., ♂; 39 - position of ocelli, 40 - palpus labialis, 41 - dorsum of thorax in lateral view (a - mesoscutum, b - scutellum, c - axilla, d - metanotum, e - propodeum), 43 - strigilis, 44 - scutellum, 45, 46 - apical margins of tergites 6 and 7, 48 - genitalia in dorsal view. Fig. 42. *Hoplosmia ligurica* (Morawitz), ♂, strigilis. Figs. 49-56. *Hoplosmia hermonensis* sp. n., ♂; 49 - four basal segments of right flagellum (holotype), 50 - scutellum (holotype), 51 - apex of right protibia in dorsal view, 52-55 - apical margins of tergites 6 and 7 (55 holotype, a - sharply impressed basal zone, finely roughened and dull between punctures, b - distal zone with strongly shining interspaces), 56 - genitalia in dorsal view. Scale: Figs 42, 43 = 0.5 mm; others = 1 mm.

more rounded, more rounded, separated by interspaces very narrow to of half puncture width. Tegulae polished, with irregularly scattered few minute punctures. Punctuation of mesepisternum slightly coarser than that of mesoscutum. Propodeal triangle polished except for basal transversal pitted zone; adjacent parts of propodeum with round sharply delimited punctures (20-30  $\mu\text{m}$ ), interspaces somewhat irregular, mostly of a puncture width, polished. Uncus of proboscis spine-like slightly curved outward. Strigilis as in fig. 59. Hind coxae with a suggestion of a carina on inner ventral angle. Inner hind tibial spurs slightly longer than half length of hind basitarsus. Hind basitarsus parallel-sided, with a small tooth in the distal fourth part of its anterior margin. Tergite 1 with well developed gradulus, disappearing laterally, its ventrolateral portion with along, sharply delimited stria. Basal concave area of tergite 1 polished. Dorsal exposed surfaces of tergites 1-7 polished throughout, generally with dense punctation being progressively



Figs. 57-64. *Osmia melenae* sp. n., ♂: 57 - three basal flagellar segments of right antenna, 58 - palpus maxillaris, 59 - strigilis, 60-62 - apical margins of tergites 6 and 7 (a - preapical margin swollen, b - apical margin edged), 63 - sternite 8, 64 - genitalia in dorsal view. Scale = 1 mm.

denser from tergite 2 to 5. Tergite 1 with broad transversal area near apical margin covered with but scattered minute punctures (15  $\mu\text{m}$ ). Tergites 2-5 with broad, slightly depressed preapical margins nearly impunctate (virtually irregularly covered with scattered minute punctures of 15  $\mu\text{m}$ , the number of which is decreasing to tergite 5) and strongly shining. Tergites 6 and 7 as in Fig. 60-62. Surface of tergite 6 feebly convex, with a broad, shallowly depressed elongate preapical zone (as indicated by the dotted line in fig. 62) and a similar but ill-defined one sublaterally. Preapical margin of tergite 6 swollen, apical margin edged. Tergite 7 with apical margin entire, provided with a small sharp tooth laterobasally. Sternite 2 large, strongly shining with somewhat irregularly scattered round shallow punctures (30-45  $\mu\text{m}$ ), separated by interspaces equal to 1-3 puncture width, apical margin broadly rounded (preapical margin broadly impunctate), concealing sternite 3 except laterally. Sternite 3 with apical margin broadly and deeply emarginated. Surface of sternite 4 shallowly concave, with punctation a little coarser than on sternite 2, apical margin broadly rounded. Sternite 8 as in Fig. 63. Genitalia as in Fig. 64.

Body length ca. 7 mm (paratypes) - 9 mm (holotype), length of fore wing 6.5-7 mm.



**I n t e g u m e n t :** black. Head, thorax and tergite 1 dark green; tergite 2 bluish-green, changing in violet laterally, impunctate preapical area green; tergites 3-5 bluish, violet, strongly shining, impunctate preapical area of tergite 3 distinctly green, those of tergites 4 and 5 but feebly so; tergites 6 and 7 weakly bluish-violet. Mandibles, scapus and pedicellus black; flagellum brownish-black. Tegulae dark, their inner portions dark green, broad outer margins paler brown. Legs and exposed portions of sternites with weak metallic aspect. Tibial spurs yellow-brown; terminal tarsal segments reddish-brown, distal halves of claws slightly darker, reddish, semitranslucent. Membrane of fore wing feebly infuscated with brown-yellow; veins dark fuscous; nervulus nearly perpendicular, interstitial; abscissa A of the cubital cell 2 twice as long as abscissa B; venation only in a narrow part basally dull yellow. Genitalia pale ochreous.

**P u b e s c e n c e :** moderately long, pale. Head whitish, frontovertex but light golden-yellow. Thorax light golden-yellow, whitish laterally and ventrally. Legs whitish, inner surfaces of basitarsi yellowish. Tergites whitish-yellow; tergites 2 and 3 in front of their preapical impunctate margins with appressed and relatively loose fasciae (hairs reaching nearly apical edge of each tergite); tergites 4 and 5 with dense appressed preapical bands. Pubescence of sternites short, whitish; dense bristles in median emargination of sternite 3 pale golden-yellow.

The species is named in honour of Miss Milena Verichová (Prague) whose assistance in regard in the entomological research of the author is much appreciated.

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## MAGELLAN GOOSE, *CHLOEPHAGA PICTA* (ANSERIFORMES) AS A MODEL OF CONVERGENT BEHAVIOUR

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**Abstract.** Because of the absence of true geese from the South American continent *Chloephaga picta*, a South American representative of the subfamily Anatinae, has colonized niches that are characteristic of this tribe in the Holarctic region. Behavioural as well as some morphological differences from its relatives of the genus *Tadorna* are described and its vocalizations are analysed.

### INTRODUCTION

The Magellan goose (*Chloephaga picta*) is a large-size species weighing up to 2.700 g (females) and 3.200 g (males). It lives in semiarid grassy pampas of South America, often rather far from the sea. Its distribution area begins at 36° of southern latitude in Chile and Argentina where it is represented by a smaller subspecies, *Chloephaga picta picta*. A larger subspecies, *Chloephaga p. leucoptera* lives on the Falklands and in South Georgia. Sexual dimorphism is pronounced. The male is white, with black wavelets on the lower neck, sides and abdomen, primaries and tail black, speculum green, secondaries and upper wing coverts white. In *Ch. p. leucoptera* the black wavelets are restricted to the sides, the rest of the body is white. Bill and legs blackish. The female has yellow legs, the body is cinnamon-coloured and rufous with black wavelets. Wings of the same colour as in the male. *Chloephaga picta picta* is sympatric with *Ch. poliocephala* and *Ch. rubidiceps*, the insular subspecies being sympatric with *Chloephaga hybrida*.

*Ch. picta* is a hardy species withstanding hard frost. Both sexes are very aggressive, especially in the breeding season. In contrast to the Andean goose in which courtship actions and charging displays of the males occur throughout the year, the Magellan goose is markedly aggressive in late winter and spring. This has been confirmed by Johnson's (1965), Weller's (1972) and Wood's (1975) field observations. These authors report that except for the nesting season the Magellan geese congregate in large flocks, often of 200 - 500 individuals. In many countries are Magellan geese persecuted because of their destruction of sheep pastures. Like all sheldgeese, Magellan geese mate for life and the pairs vehemently defend their territories in the breeding season.

I should like to point out that despite its resemblance to true geese the genus *Chloephaga* definitely belongs to ducks. Like duck, Magellan geese shed contour feathers twice a year while geese only once. Like drakes, *Chloephaga* males possess a large tympanum in their vocal apparatus. Protein electrophoresis has proved a "duck nature" of *Chloephaga*. With the exception of

the genus *Anseranas*, Anseriformes shed their flight feathers simultaneously; I found another adaptation to life in open pampas in *Chloephaga*'s gradual casting of the flight feathers.

#### MATERIAL AND METHODS

For many years I observed a group of 28 Magellan geese in the Prague Zoological Garden where they had large grassy runs, and I made additional observations in the largest collections of anseriform birds in the Wildfowl and Wetland Trust during my several working visits to the United Kingdom. I also had an opportunity to watch Magellan geese in the wild for a short time. I made film and photographic recordings of their behaviour, monitored their daily activities and care for the young, and analysed their vocalizations using a Kay Elemetrics sonograph. Altogether 2400 standard 15' samples were evaluated.

#### RESULTS

##### a) General behaviour

Contrary to the genus *Tadorna* which belongs to the same tribe as *Chloephaga* Magellan geese are not restricted to water. According to Woods (1975), they live in open pampas far from water, and they enter water relatively rarely even in zoos. They walk easily, without a trace of the waddle typical of ducks, which is due to the centre of gravity being alternately shifted from one leg to the other. During fights in the breeding season they run quickly and nimbly, which is unusual in ducks. Most *Chloephaga* species in South America have assumed the role which geese of the Anserini tribe play in the Holarctic region. While the animal component prevails in the food of most *Tadorna* species, members of the genus *Chloephaga* have become exclusive vegetarians. This ecoethological adaptation to a vacant niche has produced morphological changes, namely enlargement of the cere and a rearrangement of the locomotor apparatus. The femur of *Tadorna tadorna* makes up 20.22 % of the leg length, while 21 % in *Chloephaga picta*. The length of the tibiotarsus has grown to 37.8 % in the Magellan goose compared with 34.1 % in *T. tadorna*, and the tarsometatarsus of *Ch. picta* has lengthened to 23 % (20.2 % in *T. tadorna*). On the other hand, the middle toe of the Magellan goose is markedly short, like in all good walkers, making up 12.2 % of the leg length, while in the good swimmer *T. tadorna* the middle toe forms 24.7 %. These numbers are means of 28 specimens. Also the bill of *Ch. picta* which feeds on grass is 14 % shorter compared with *Tadorna* species. The Magellan goose has become quite different from ducks in the length ratios of the skeletal elements of the leg, and has adapted much more to terrestrial life than true geese which are more dependent on water. The length ratios of the leg bones are almost identical with those in the terrestrial Australian genus *Cereopsis* whose position is unique in the order.

##### Daily activity

Würdinger (1978) made a detailed analysis of feeding in geese of the genus *Anser*. For comparison, I observed 28 Magellan geese in their large grassy runs where they were not disturbed by visitors for the duration of sleep and rest, preening, locomotion and feeding at regular 15-minute intervals from 5 a.m. to 1 a.m. for three years during the four months when courtship and breeding were taking place (Fig. 2). Since it was a comparative study my observations had to be of the same duration as in Würdinger's (1978) study of similar questions in *Anser indicus*.

The values given below were obtained by observing 28 individuals, young and adult, for

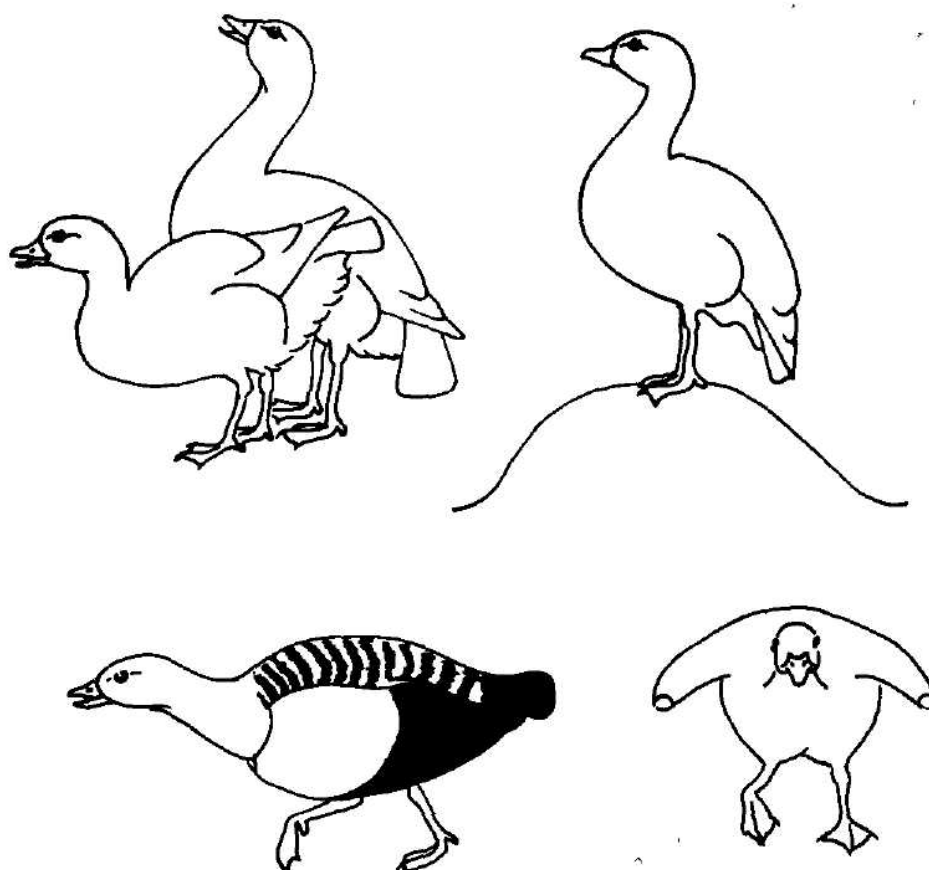


Fig. 1. Behaviour of the Magellan Goose: 1 - female inciting, male in the epigamic display, 2 - male - charging display posture, 3 - 4 - male provoked by female to attack jerks his wings from the side coverts and the white wing coverts are used as aggressive releasers.

three years. At that time the Magellan geese were kept in grassy runs in breeding grounds of the zoo where they were negligibly disturbed by visitors.

a) **Sleep and rest.** Adult as well as young birds sleep and rest mostly lying on the abdomen, or the adults stand on one leg which they alternate. The sleeping shellgeese open their eyes from time to time and if they do not notice anything unusual they close them again and sleep on. If they are not disturbed they go through 5 to 7 periods of sleep and rest between 5 a.m. and 1 a.m., which alternate with periods of activity. The average duration of sleep is 22-23 mins., the average period of rest, mostly on one leg and with a frequent opening and closing of eyes, lasts 30-34 minutes. During courtship and nesting the males regularly chose elevated roosts, high molehills and stumps.

the Magellan geese was much longer in winter than in summer, which Würdinger (1978) reported for geese too, the apparent reason being that in this Middle European country snow cover prevented the birds from feeding on grass. I could not verify this presumption in the field. Sleep is at minimum in early morning hours, reaching maximum values at noon and in the early afternoon. The pattern is different in July when parents spend most of daytime by guarding their young, so that the sleep maximum is postponed till evening. In August, when the young have reached maturity, the sleep curve gradually returns to normal. There is an 80-86 % similarity

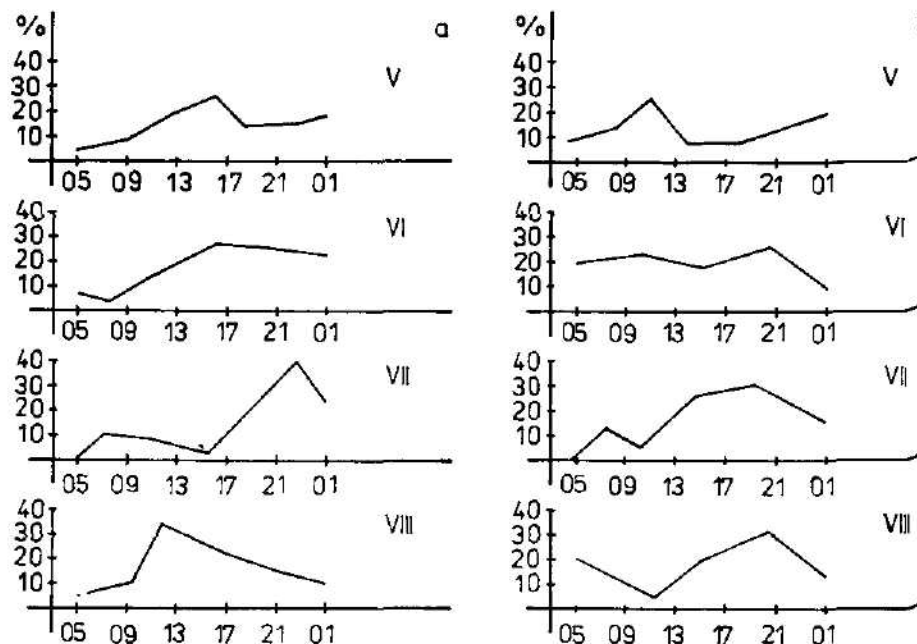


Fig. 2. Daily activity of sleep - a and comfort behaviour - b in % in 15 minutes intervals from 5 a.m. to 01 a.m. during the breeding season (May - August).

between the sleep patterns in goslings, whose mean values are included in the diagrams, and their parents. However, goslings sleep on the whole longer than adults, on the average falling asleep earlier by 8 - 10 % and sleeping 7 - 10 % longer when the adults have woken up. The similarity of sleep patterns in goslings and their parents decreases to 55 % in July when the young are growing up and to mere 30 % in August. A biological reason for this disproportion is that like other birds in cold regions the young spend more time by feeding to the detriment of sleep to meet a higher need of energy during growth.

b) Comfort behaviour. This behaviour, similarly as the pattern of sleep, filled 6-7 periods during the hours of daily observations. The curves show different maxima in different months. In families, the male and the female preen themselves at different times, apparently because of the necessity to protect the young. One of the parents always guards the family

Magellan geese in pairs without offspring preen themselves at the same time (80 %). Gosling preen themselves with one of the parents (over 70 % of the time). Preening reaches the maximum in July, apparently owing to the moulting of plumage, like in other Anseriformes.

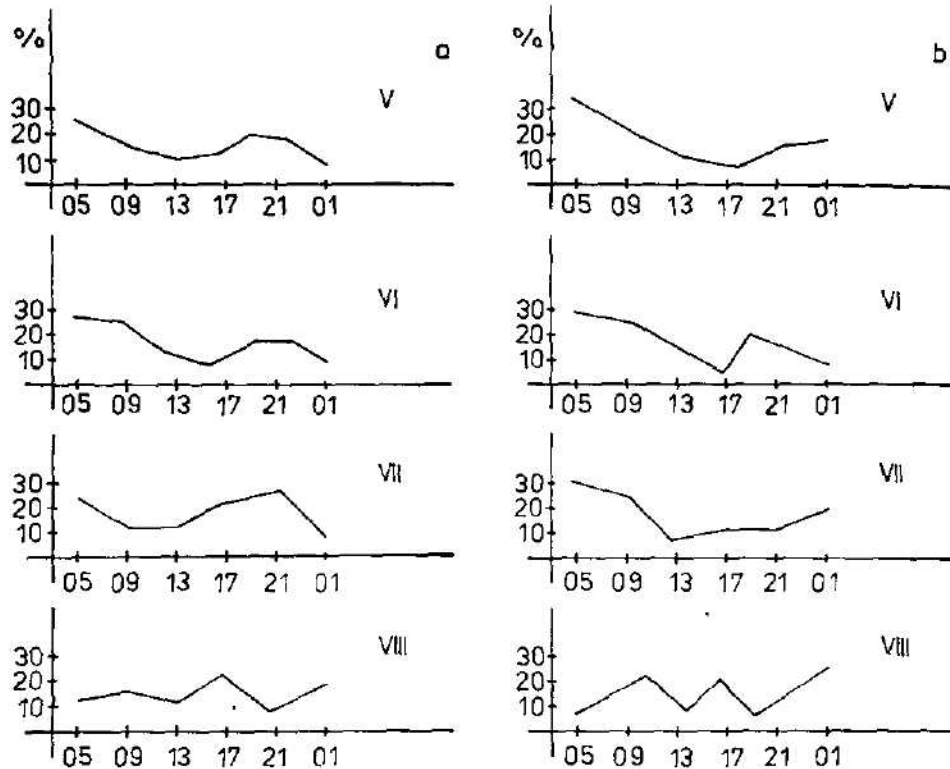


Fig. 3. Daily activity of locomotion - a and feeding - b, in % in 15 minutes intervals from 5 a.m. to 1 a.m. during the breeding season (May - August).

c) **Locomotion**. The diagrams show that locomotion is at the maximum almost always in the morning in connection with feeding, and there is another peak in the evening for the same reason. Locomotion increases in July when the young start to fly; the increase may stem from preparations for migration to winter quarters, but course this cannot be proved in zoological gardens (Fig. 3).

d) **Feeding**. Magellan geese typically feed on grass. This has been proved by observations of free-living birds and by analyses of their stomach contents. Large flocks of these birds feed on grass so effectively that for example in Terra del Fuego they compete with sheep for pastures; according to Weller (1972), local authorities decided to destroy 75,000 eggs annually to reduce the population of Magellan goose. Curves for individual months, indicating the proportion of feeding in daily activities, are largely similar to locomotion curves. Until August, feeding is most intensive in early morning hours and there is another peak in the evening. The curve changes conspicuously in August owing to preparations for migration and rela-

ted unrest, with the maximum shifting to evening hours. However, the mean curves do not show some differences which were recorded. Both parents feed together for only 40 - 42 % of the time during nesting in May, each feeding alone for 60 % of the time while the other looks after the nest and goslings. As the young grow the percentage of joint feeding increases, so that in August each parent spends only 20 - 25 % of the feeding time alone. Before they can fly, the young spend 90 % of the feeding time in May, 82 % in June and 69 % in July with one of the parents. In addition to the joint feeding, they feed much more than the adults. According to Burton & Hudson's (1978) data from nesting places of the snow geese in Canada, six-week old goslings feed for 85 % of 18 hours of daylight. I did not determine these differences in the Magellan geese in Central European latitudes, also because they were given grain as additional food. However, there is statistical evidence that dependence on parents decreases once the young are able to fly, and I recorded joint feeding afterwards only in 40 % of cases.

Comparing *Chloephaga* with the genus *Anser* where the percentages had been recorded in circumstances resembling mine I found almost no differences that would have been statistically significant. This confirms a finding made by McFarland (1989) in other species of birds, i.e., that the same kind of food is obtained by similar feeding strategies. I should like to point out that another parallel can be found in defensive behaviour. After the breeding season, *Anser* as well as *Chloephaga* feed in large flocks, which substantially reduces the risk of sudden attacks by predators.

b) **Social behaviour** The tribus Tadornini is transitional between Anserinae and Anatinae, because sexual dimorphism is conspicuous in its members *Chloephaga picta* and *Ch. hybrida*, whereas there is no sexual dimorphism in the other three species, *Chloephaga melanoptera*, *Ch. polocephala* and *Ch. rubidiceps*. In the genus *Tadorna* which also belongs to Tadornini the sexes differ in colouration, but the differences are not conspicuous except for *Tadorna variegata*. Kear (1970) related sexual dimorphism to the type of conjugal state and participation of the partners in care for the young. True geese, in which there is no sexual dimorphism, mostly mate for life. In contrast, ducks where the males multicoloured do not form permanent pairs. In general, shellgeese mate for life regardless of sexual dimorphism or lack of it and the males take an active part in rearing the young, similarly as in true geese and swans. In Anseriformes, pairs are formed for life or at least for several seasons in the genera *Chauna*, *Anhimas*, *Anseranas* and all members of the subfamily Anserinae. Contrary to previous beliefs, families may break up, but this happens very rarely. A bird which loses its partner finds another. *Anseranas* is unique because a male usually takes two or three wives. In Tadornini, pairs are permanent too, but the female is the dominant element; she may leave her partner and choose another one. I observed this behaviour in *Tadorna variegata* where mere 10 minutes for which a male was separated from his partner were enough for her to choose another, and the new pair chased away the previous husband. It seems then that some members of *Tadorna* may form new pairs each year. Pairs are permanent in *Chloephaga*, but if one of the partners dies he or she is quickly replaced.

Optical characters on the head seem to be an important signal in pair forming, even in species where colouration is the same in both sexes. Many times I saw a male attacking his own female when her head was submerged in water. The attack stopped as soon as she raised her head.



Acoustic signals are equally important in courtship and mating.

Heinroth (1911) termed sounds which geese make during courtship a "triumphal cry". This call, which both partners give out when they have chased away a rival, serves at first for cementing the bond between them and facilitates mutual recognition. Fisher (1965) proved that this call has gradually taken on the function of a social bond because not only the parents but also their grown-up offsprings use it. Essential is that both partners use this call-note also outside of the breeding season, which means that it unites the pair throughout the year. By field observations and a study of tape recordings I found that a duet plays a similar role in the genus *Chauna*. Duets have been described in tropical song birds, and their occurrence in Anseriformes has been proved by analysing the voices of both partners. There is no doubt about the social role of such calls.

There are transitions between different colourations as well as vocal signals in the Tadorini. The females have developed a peculiar form of behaviour including a specific call-note, so-called inciting (Hetzen). This typical female signal provokes the male to attack a rival or any other bird in the breeding season and proves the specific leading role of the female of this tribe. It also has much in common with the triumphal ceremony in Anserini, because it occurs throughout years, which means that its function is social as it maintains the pair bond.

**A g g r e s s i v e   a n d   s e x u a l   b e h a v i o u r** (Photos 1-4, see the end of this issue)

Inciting by the female, its vocal component in particular, resembles that in the related Andean goose. However, the inciting Magellan goose does not raise her wings, but the whole hind part of the body. In this slanting position she walks around the male and slightly moves her head up and down as if she were feeding. Apparently, these are intentional movements developed from feeding by its ritualization. Unlike the Andean goose, the inciting Magellan goose does not wobble her tail (Fig. 1).

Courtship and attack actions of the male are markedly simplified, apparently owing to the conspicuous sexual dimorphism. In contrast to the related Andean goose, the Magellan gander never ruffles up his feathers or shakes his body, there are no rolling movements of the head on the back and no flapping of the wings. The male responds to the female's inciting by standing erect in a threatening attitude, stretching out his neck and making loud whistling sounds. The more aggressive his mood the more he bends his neck backwards and the shorter and more frequent are his whistles. After the brief threat, the female's inciting mostly provokes the male to attack. He jerks his wings from the side coverts and holds them partly spread, with the massive protuberances of the wrist and white coverts displayed. The body is dorsoventrally flattened. Fights between the males are really the most ferocious shows of aggression in Anseriformes. The two males hold each other firmly, pinching the other's neck and trying to knock the rival down by powerful blows of the wings. During such fights they often literally roll on the ground. The fight continues until one of the ganders, often wounded, pulls his feathers close to the body, inclines his head backwards to show submission and runs away. The victor returns to the female, holding his body erect. She begins to incite him in a gurling voice and the male utters high-pitched whistles. Both partners slowly walk around each other in these positions. In my opinion, this behaviour is a typical triumphal ceremony, although much simplified in comparison with *Anser* species. During nesting and even before it the male stands most of the time erect in

a threatening attitude at the highest point of his territory, apparently guarding it. He rest and sleeps there too. In the meadow where we keep the Magellan geese in the zoo the ganders use molehills and stumps for the charging display. The striking white colour seems to intimidate others, young birds in particular.

**Mating behaviour.** I observed mating several times, mostly on the ground, but also in shallow water. Prior to mating both partners repeatedly bow their heads in the same way as when they start bathing; it seems to be a highly ritualized dipping of the head, which is common in the other shell-geese and in true geese. These movements are sometimes accompanied by flapping of the wings. After the mating the male jumps down from the female's back and both slightly raise their wings for a few seconds.

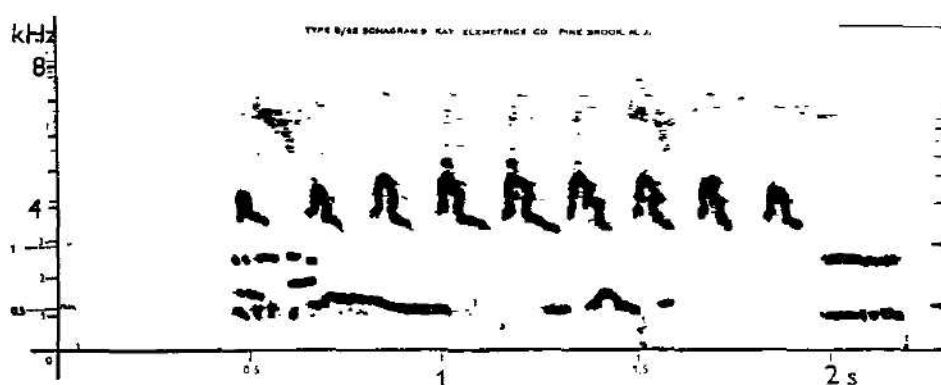


Fig. 4. Sonagram of the whistles of the male incited by the female.

**Vocalizations.** The male whistles at a high pitch, which sounds as ("vau-vau-vau") in the charging display, the female has a deep gurling voice ("grrr-grrr"). During the triumphal ceremony the male utters short whistles ("ve-ve-ve"). The call-note of the female walking with her brood is a higherpitched ("ko-ko-ko").

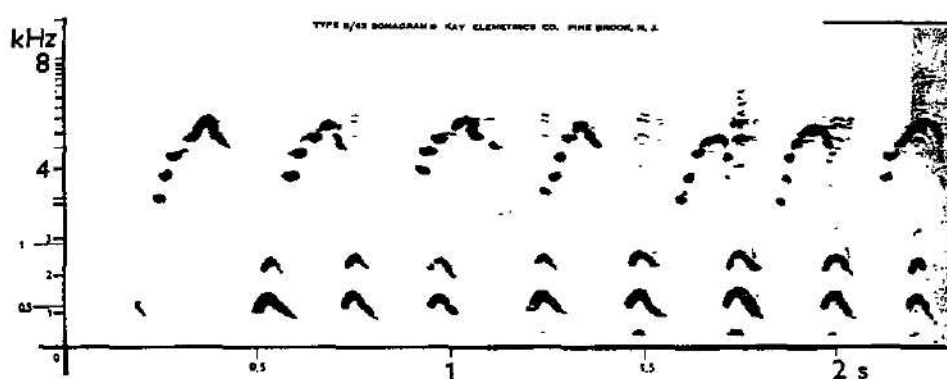


Fig. 5. Sonagram of the calling male and female during the triumphal ceremony.

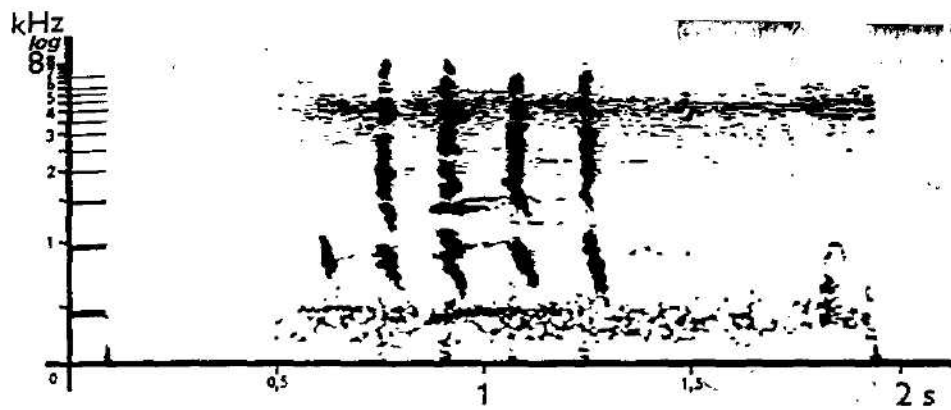
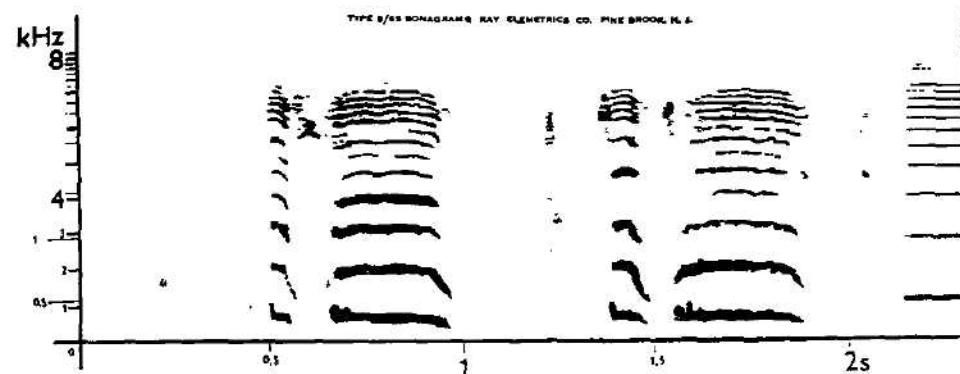
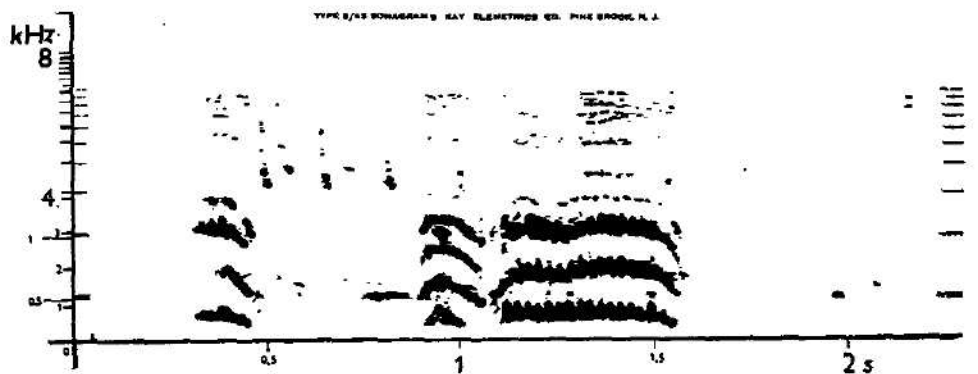


Fig. 6. Sonagram of the aggressive voice of the male.



Figs 7,8. Sonagrams of the inciting voice of the female.

Sonagram 1. (Fig. 4.) shows high-pitched, long whistles of the male incited by the female.  
Analysis: Time basis 2.4 s, frequency spectrum 8 kHz, scale logarithmic, divisions by 0.5 kHz.

The energetic part of the signal is repeated at intervals of about 168 ms, i.e., 6 times per second. The call starts quietly at 0.7 kHz and steeply rises to about 2.2 kHz, then sinks again, steeply at first, then slowly to 1.2 kHz and steeply back to 0.7 kHz. The signal runs in waves with energy peaks.

Sonagram 2. (Fig. 5.). A joint call of the male and female at the triumphal ceremony. Time basis 2.4 s, frequency spectrum 8 kHz, scale logarithmic, divisions along the ordinate by 0.5 kHz. The female voice is deeper although it includes higher harmonics than that of the male, in which the first 4 signals are repeated at intervals of 330-370 ms, the last three signals at 260 ms. Duration 150-185 ms. Analysis of the first signal: The frequency increases continuously from 1.25 to 4 kHz within 150 ms (with emphasis on frequencies of 1.5, 2, 2.5 and 3 to 4 kHz). The signal then loses pitch and intensity, sinking continuously to 1.4 kHz within approximately 30 ms. The course of the female's call is similar to that of the male, being repeated at intervals of 225-260 ms. Duration 90-110 ms. Analysis of the sixth signal of the female (between signals 4 and 5): The signal consists of two simultaneous parts, the deeper one including frequencies (higher harmonics) of 0.3, 0.6, 0.9 and 1.2 kHz in the maximum of frequency amplitude. The signal rises for about 1/3 of the period, then sinks for about 2/3 of it. The other, higher-pitched and less energetic part is centred around 4 kHz, sounding like a continuous spectrum from 1.5 to 8 kHz.

Sonagram 3. (Fig. 6.). Voice of the male in an aggressive mood, short, repeated ("ve-ve-ve") signals. Time basis 2.4 s, frequency spectrum 8 kHz, scale logarithmic, divisions by 0.5 kHz. Repetitions at intervals of 150-180 ms, duration of one signal about 50 ms. The whole frequency spectrum is almost continuous. Frequencies between 0.8 and 1 kHz as well as 1.5 and 6 kHz are emphasized. Note: Background noise of the city interfered with the signal between 0.5 and 4.5 kHz throughout its duration.

Sonagram 4. and 5. (Fig. 7,8). Inciting voice of the female. Time basis 2.4 s, frequency spectrum 8 kHz, scale logarithmic, divisions by 0.5 kHz. The diagram shows three signals. The first lasted 230 ms, the male whistled 3 times during the following 400 ms intermission; the second signal, lasting 170 ms, was followed by a third of 530 ms. Characteristic of this call is the basic frequency of about 0.3 - 0.4 kHz and the second (0.6 - 0.8 kHz) and third (0.9 - 1.2 kHz) harmonics. It includes other higher harmonics whose energy is insignificant and noise of up to 8 kHz. All the harmonics are modulated by a frequency of about 44 kHz. It drowns the basic frequencies which the human ear seems unable to distinguish. Therefore, the human ear largely perceives the deep modulation frequency of about 44 kHz and the voice seems to be deep although it includes higher frequencies.

## DISCUSSION

I have already said in Introduction that the ethology and ecology of the Magellan goose have not been investigated with the exception of studies by Johnson (1965), Weller (1972) and Woods (1975). Their studies were made in the field and the results are basic biological data mainly on breeding. These data fully correspond with my findings made in birds reared in captivity, especially as regards a decrease in aggressiveness after the nesting season, which enables the birds to congregate in large flocks. As concerns changes in the feeding behaviour of

this anatine species, I compared my results with those of Würdinger (1978) who had thoroughly studied feeding strategy in the genus *Anser* and found practically no difference in the feeding activity and strategy of the shellgeese observed by me and the true geese. By its behaviour, *Chloephaga picta* very much resembles the aberrant genus and species of anseriform birds, *Cereopsis novaehollandiae* (Veselovský 1970, 1973). Notes on the ethology of *Chloephaga picta* can be found in the comprehensive and I would say descriptive works of Johnsgard (1965, 1968) and Kear (1968, 1970). Very accurate observations of some members of the tribe Tadomini are included in the fundamental ethological studies by Heinroth (1911) and Lorenz (1965). I based my research on these findings and because the amount of my material was much larger I could supplement and correct a number of descriptions. Johnsgard (1961) was the first to analyse the voices of Anseriformes in some of their representatives, and Kear (1968) analysed the voices of young birds. The detailed description of the voice of *Chloephaga picta* is the first of its kind. I could base it on my previous research in the related genera *Tadorna* and *Cyanochen* (Veselovský 1982, 1986, 1988).

#### SUMMARY

The behaviour of the South American Magellan goose (*Chloephaga picta*) is described with the aim to show how in Anseriformes, an otherwise compact group, individual tribes, genera and species have developed quite different forms of feeding behaviour in the course of evolution. The genus *Chloephaga* has colonized a niche which, in the Holarctic region, is occupied by anseriform genera and species of the tribe Anserini which does not occur in South America. This behavioural adaptation induced morphological changes in the structure of the bill, alimentary canal and locomotor apparatus. In addition to descriptions of daily activities and their modifications during the growing season, the social behaviour of the species is examined and the vocalizations of both sexes are described and analysed.

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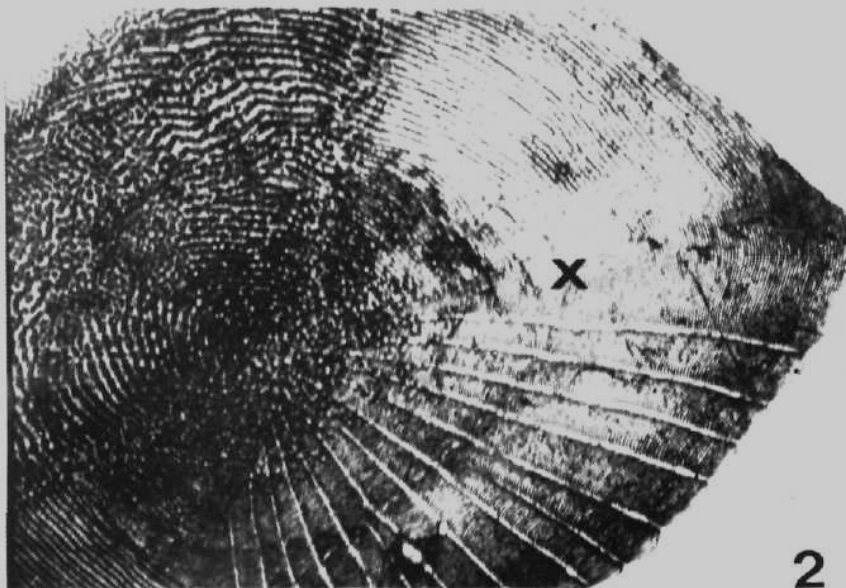
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1



2

Photo 1. The scale of *Oreochromis niloticus* caught in the Gebel Aulia Reservoir on Febr.,23,1984. Body length 80 mm, total length 101 mm, weight 16 g, age 0+.

Photo 2. The scale of *Oreochromis niloticus* caught on Aug.,18,1989 in the Gebel Aulia Reservoir (locality Kosti). Body length 230 mm, total length 270 mm, weight 330 g, age 1+.



HANEL L. & M. KHALID: Length and weight growth in *Oreochromis niloticus* (Pisces, Cichlidae) from Gebel Aulia reservoir and Lake Nubia in Sudan

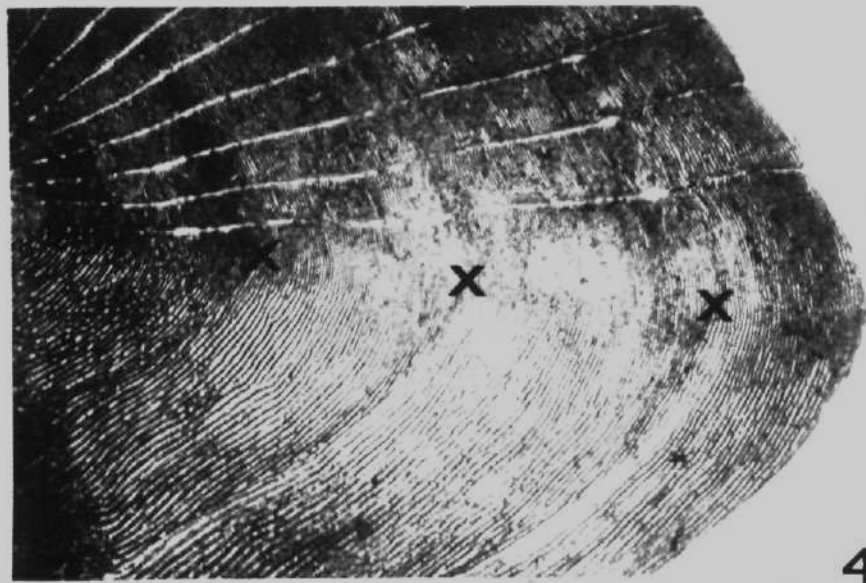
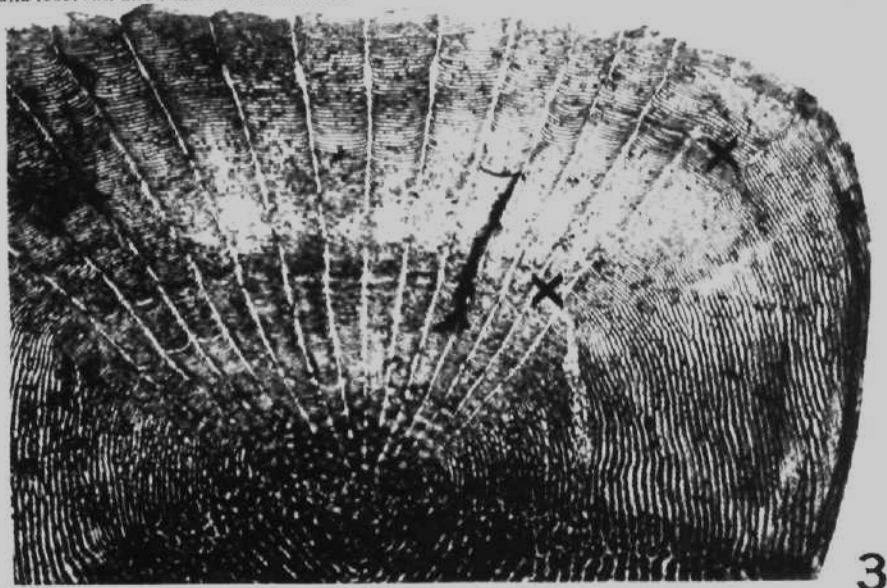


Photo 3. The scale of *Oreochromis niloticus* caught on March, 20, 1989 in the Lake Nubia. Body length 330 mm, total length 450 mm, weight 25050 g, age 2+.

Photo 4. The scale of *Oreochromis niloticus* caught on Nov., 23, 1988 in the Gebel Aulia Reservoir (locality Redeis). Body length 270 mm, total length 430 mm, weight 1520 g, age 3+.

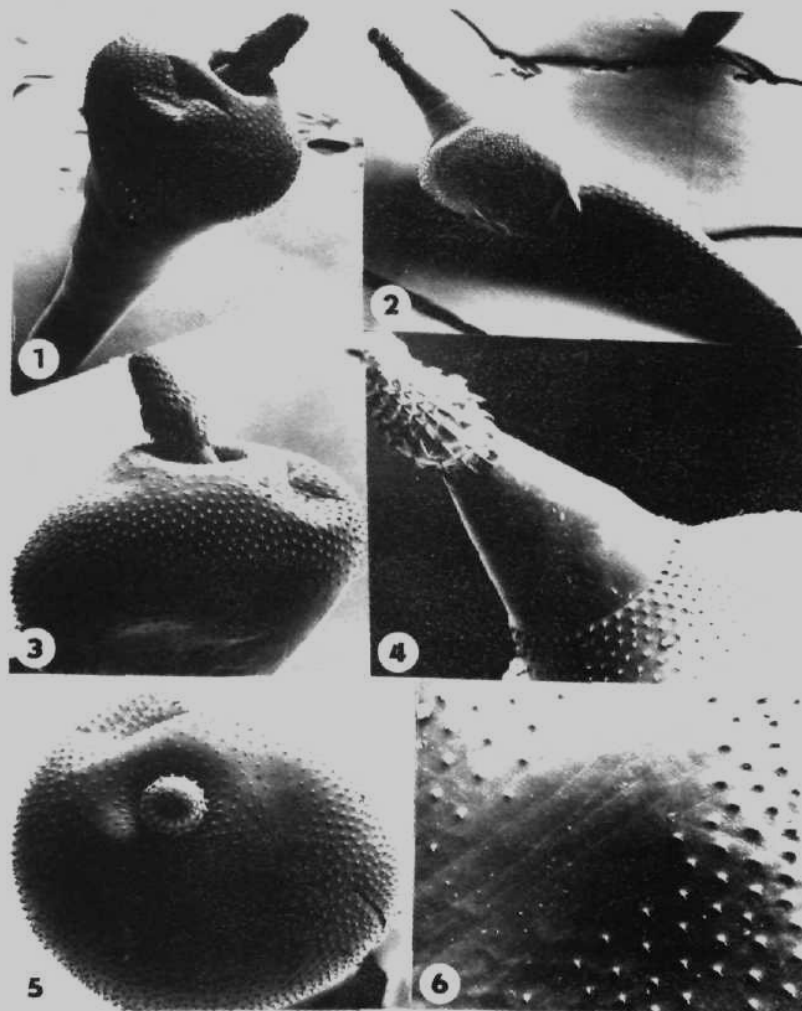


Plate I. *Andracantha phalacrocoracis* (Yamaguti, 1939). Scanning electron photomicrographs. Fig. 1 - total view of male; magnification x 27; Fig. 2 - total view of female; x 19; Fig. 3 - trunk of male, lateral view; x 38; Fig. 4 - everted proboscis of female and anterior field of spines on trunk; x 67; Fig. 5 - trunk of male, apical view; note small bare zone only partly separating anterior and posterior fields of spines; x 41; Fig. 6 - bare zone of female; x 125.

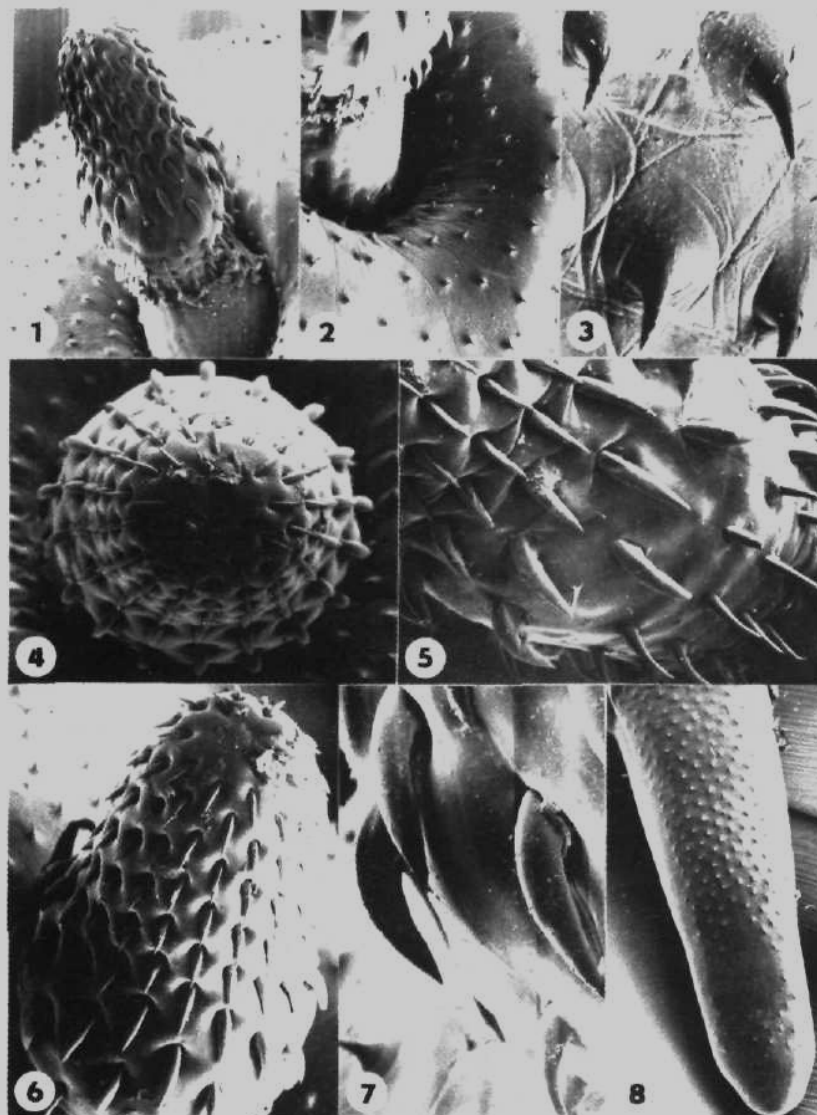


Plate II. *Andracantha phalacrocoracis* (Yamaguti, 1939). Scanning electron photomicrographs. Fig. 1 - proboscis of male; magnification x 95; Fig. 2 - trunk spines surrounding proboscis of male; x 145; Fig. 3 - detail of spines on trunk of male; x 1065; Fig. 4 - proboscis of male with 18 longitudinal rows of hooks, apical view; x 205; Fig. 5 - hooks of middle part of proboscis of male; x 305; Fig. 6 - anterior part of proboscis of male; note posteriorly increasing hooks; x 195; Fig. 7 - detail of largest hooks (mostly hooks VI) on proboscis of male; x 550; Fig. 8 - spines on posterior part of female body; x 37.

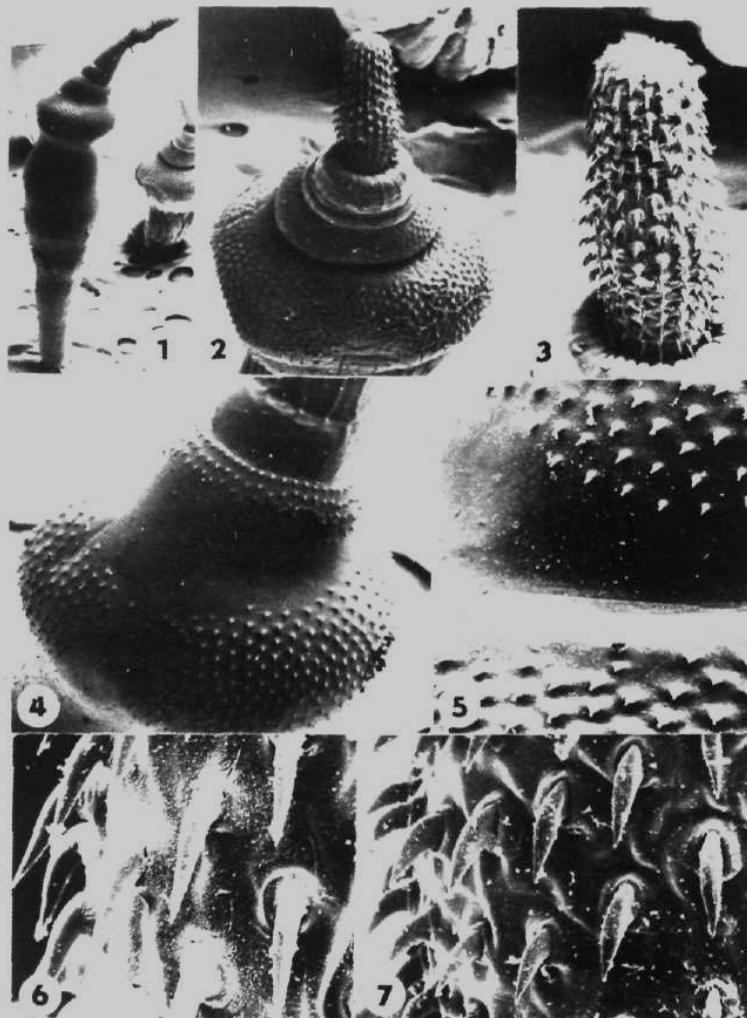


Plate III. *Southwellina hispida* (Van Cleave, 1925). Scanning electron photomicrographs. Fig. 1 - total view of female; magnification x 12; Fig. 2 - a specimen (sex not identified) with not fully everted proboscis and trunk; x 36; Fig. 3 - proboscis; x 58; Fig. 4 - trunk of female with well visible two fields of spines, separated with bare zone; x 58; Fig. 5 - detail of trunk spines and bare zone of female; x 175; Fig. 6 - detail of anterior hooks on proboscis; x 525; Fig. 7 - detail of largest hooks in middle of proboscis; x 290.

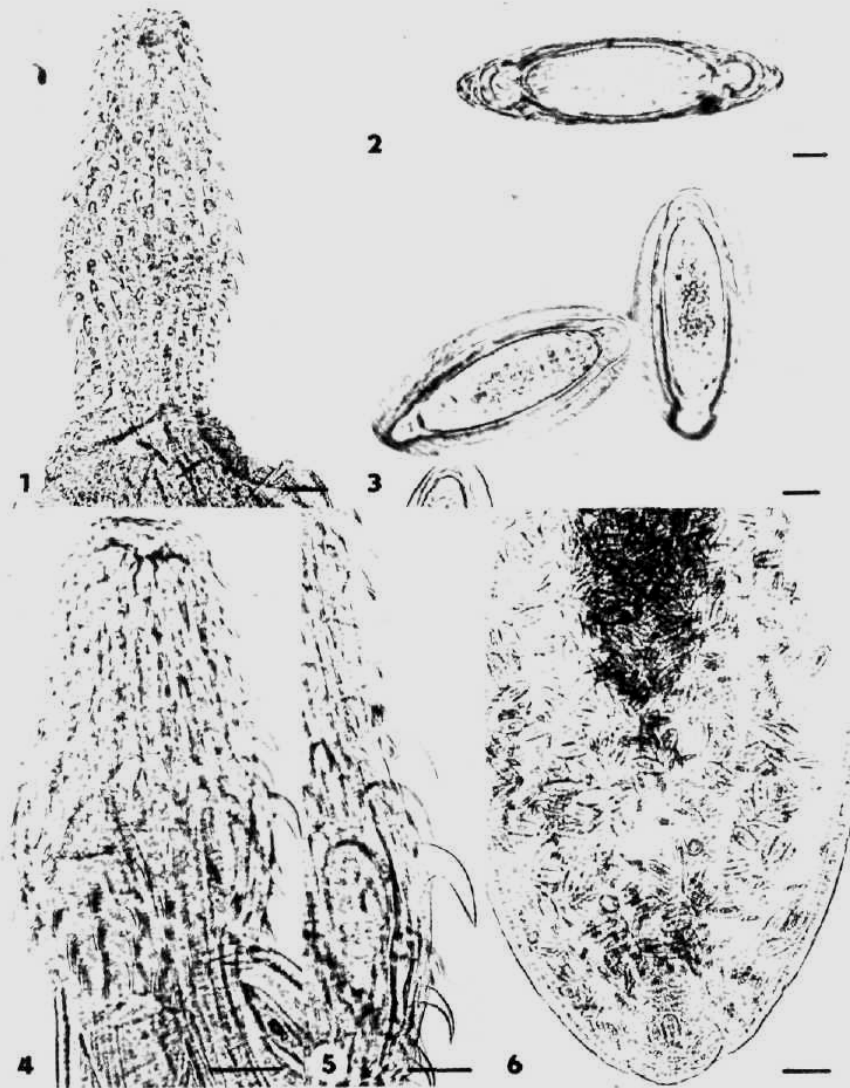


Plate IV. Fig. 1 - *Southwellina hispida* (Van Cleave, 1925), proboscis; Fig. 2 - *S. hispida* - egg; Fig. 3 - *Andracantha phalacrocoracis* (Yamaguti, 1939) - eggs; Fig. 4 - *A. phalacrocoracis* - proboscis; Fig. 5 - *A. phalacrocoracis* detail of hooks in middle part of proboscis; Fig. 6 - *A. phalacrocoracis* - posterior part of female. Scale bars: Figs. 1, 4, 6 - 100  $\mu$ m; Figs. 2, 3 - 10  $\mu$ m; Fig. 5 - 50  $\mu$ m.

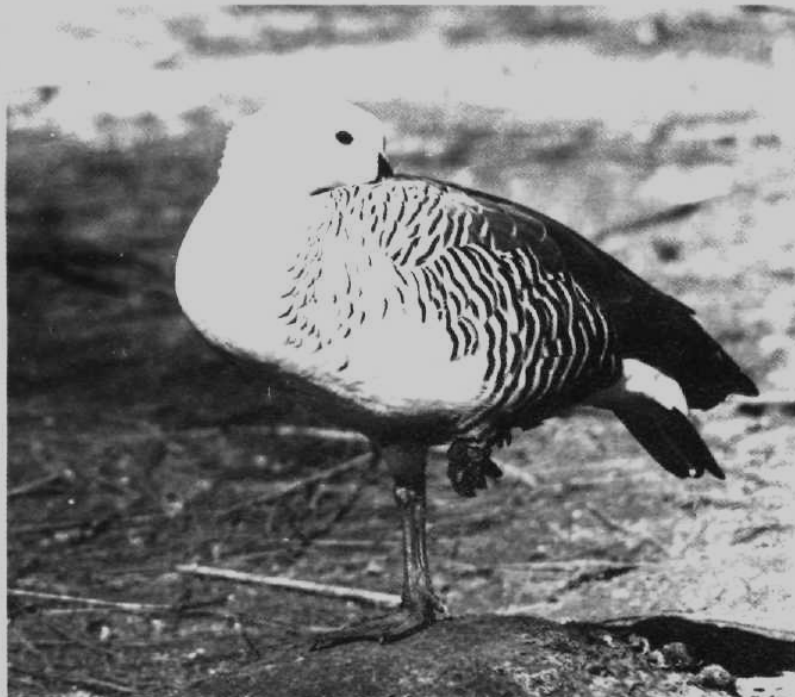


Photo 1. Pseudo - sleeping posture of the male during the breeding season.

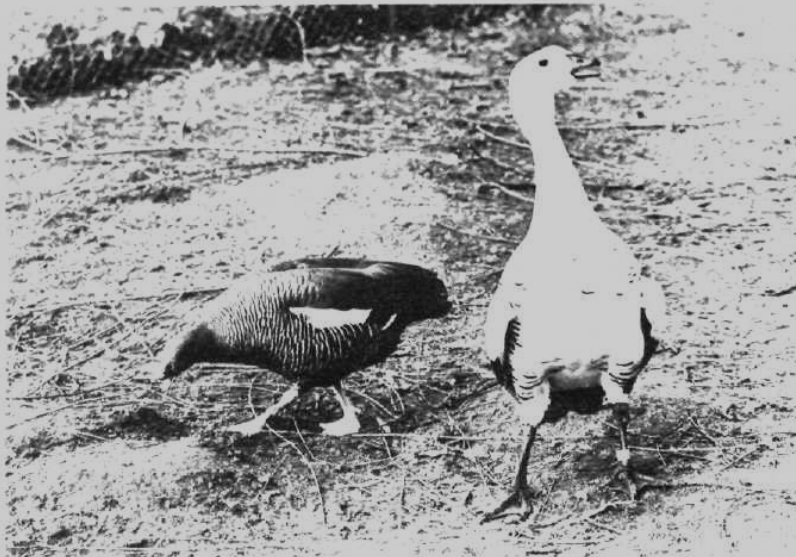


Photo 2. Female inciting the male.



Photo 4. Two fighting males.



Photo 3. Male starting to attack.



## INSTRUCTIONS TO AUTHORS

*Acta Societatis Zoologicae Bohemoslovacae* publishes in English, original papers on general, applied and systematic zoology biographies and book reviews. Papers by members of the Czechoslovak Zoological Society are preferred. It is understood that manuscript submitted are not offered to any other journal for prior or simultaneous publication.

Authors of taxonomic papers must respect the articles of the International Code of Zoological Nomenclature (Third Edition, 1985) and to observe its recommendations. The manuscript, including footnotes, references and tables, must be typed with double spacing (30 lines per page) on side A4 paper (210 mm x 297 mm), in duplicate, and should be not longer than 30 pages. Pages must be numbered throughout the manuscript.

### Formal arrangements

**Heading** Title of the paper, full name of author, place of work with full address - each on separate line.

**Abstract** in English, summarizing concisely the contents of the paper and indicating the relevance of the work, should not exceed 20 type-written lines.

**References** within the text Dryden (1968), (Lattin, 1967), Kumari & Nair (1967), Tmíro et al (1970), the full citation should be given in the list of references, under References authors should be cited in the alphabetical order with the papers of individual authors arranged chronologically. The titles of papers should be cited in full followed by abbreviations of periodicals in accordance with The World List of Scientific Periodicals, 4th edition, Butterworths, London (1964-1965). The number is to be given (in parentheses) only when individual numbers are paginated independently (see example b). References to papers published in languages other than the major ones, or printed in characters other than Latin, should include English translation (in parentheses), with an appropriate note at the end (see example c). Cyrillic alphabet should be transferred in Latin after ISO Recommendation R9, International system for the transliteration of Cyrillic characters, 1st edition, October 1955 or by Zekalíe R. 1964 *Pedobiologia*, 4: 88-91. Examples: (a) Dryden G. L. 1968. Growth and development of *Suncus murinus* on Guam. *J. Mammal.*, 49: 51-62. (b) Lönnberg F. & C. Gustavson. 1937. Contribution to the life-history of the striped wrasse. *Ark. Zool.*, 29 (7): 1-16. (c) Lattin G. de 1967. Grundriss der Zoogeographie. Jena. Fisher. 602 pp. (d) Makin D. 1987. The status of bats in Israel, pp. 403-408. In: Hanak V., Horáček I. & J. Gaisler (eds). European bat research. Praha: Charles Univ. Press, 718 pp. (e) Iesař Z. 1972. (Complementary notes to "Fauna ČSSR - Lamellicornia I and II") *Acta Mus. Sil., ser. A*, 21: 73-87, (in Czech, Germ. abstr.).

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